

# PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2000-263799

(43)Date of publication of application : 26.09.2000

1)Int.Cl.

B41J 2/16  
B41J 2/045  
B41J 2/055

1)Application number : 11-340178

(71)Applicant : SEIKO EPSON CORP

2)Date of filing : 30.11.1999

(72)Inventor : TAKAHASHI TOMOAKI  
USUI MINORU  
KITAHARA TSUTOMU

0)Priority

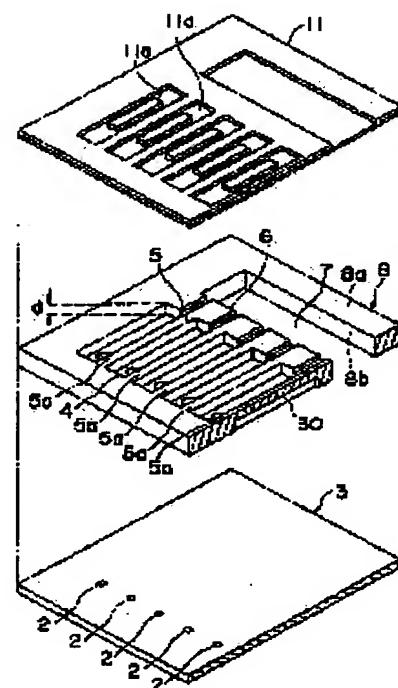
Priority number : 11004817 Priority date : 12.01.1999 Priority country : JP

## 4) INK JET RECORDING HEAD

7)Abstract:

PROBLEM TO BE SOLVED: To keep durability and to reduce production cost.

SOLUTION: A flow passage unit is constituted by laminating a nozzle plate 3 having a plurality of nozzle orifices 2 bored therein, a flow passage forming substrate 8 having a plurality of pressure generating chambers 5 communicating with a plurality of the nozzle orifices 2 and a reservoir 7 supplying ink to a plurality of the pressure generating chambers 5 through a plurality of ink supply ports 6 and including mutually opposed first and second surfaces 8a, 8b and a lid material 11 sealing the first surface 8a of the flow passage forming substrate 8. Piezoelectric vibrators for pressurizing the ink in the pressure generating chambers 5 are provided. A through-hole becoming the reservoir 7 is formed in the metal plate material including the first and second surfaces 8a, 8b so as to pierce the first and second surfaces 8a, 8b and a plurality of recessed parts becoming a plurality of the pressure generating chambers 5 are formed to the first surface 8a of the metal plate material by press processing to constitute the flow passage forming substrate 8.



## CLAIMS

## Claim(s)]

Claim 1] It has the nozzle plate which drilled two or more nozzle orifices, and the reservoir which supplies ink to 1 or more pressure generating room and said two or more pressure generating rooms which are open for free passage to said two or more nozzle orifices through two or more ink feed hoppers. The passage formation substrate containing the 1st page which counters mutually, and the 2nd page, and the lid material which closes 1st page of said passage formation substrate, A laminating is carried out and it has the constituted passage unit and a pressure generating means to pressurize the ink inside said pressure generating room. Said passage formation substrate Penetration formation of the through tube which serves as said reservoir at the metal plate containing the 1st page and said said 2nd page is carried out from said 1st page to said 2nd page. The ink jet recording head characterized by forming two or more crevices used as said two or more pressure generating rooms in said 1st page of said metal plate by press working of sheet metal, and being constituted.

Claim 2] The ink jet recording head according to claim 1 characterized by carrying out flat-surface finish of said 1st page of said metal plate after said press working of sheet metal.

Claim 3] The ink jet recording head according to claim 1 or 2 characterized by being formed in said two or more devices where two or more crevices used as said two or more ink feed hoppers serve as said two or more pressure generating rooms by said press working of sheet metal, and coincidence.

Claim 4] Both said pressure generating room and said ink feed hopper are an ink jet recording head according to claim 3 characterized by being formed in said 1st page of said metal plate.

Claim 5] Said crevice which forms said ink feed hopper is an ink jet recording head according to claim 4 characterized by being formed more shallowly than said crevice which forms said pressure generating room.

Claim 6] It is the ink jet recording head according to claim 3 characterized by having further the feed hopper passage hole which said pressure generating room is formed in said 1st page of said metal plate, and said feed hopper is formed in said 2nd page of said metal plate, and opens said pressure generating room and said feed hopper for free passage.

Claim 7] The ink jet recording head according to claim 6 characterized by carrying out flat-surface finish of both sides of said metal plate after said press working of sheet metal.

Claim 8] An ink jet recording head given in claim 1 characterized by forming the crevice for bosselation in said 1st page of said metal plate by press working of sheet metal in order to form a ridge in said 1st page of the circumference of said crevice used as said pressure generating room, in case said crevice which serves as said pressure generating room in said press working of sheet metal at said 1st page of said metal plate is formed thru/or any 1 term of 7.

Claim 9] Said crevice for bosselation formed in said 2nd page of said metal plate is an ink jet recording head according to claim 8 characterized by being formed in two or more fields corresponding to two or more walls which divide said adjoining pressure generating rooms.

Claim 10] Said crevice for bosselation formed in said 2nd page of said metal plate is an ink jet recording head according to claim 8 characterized by being formed in two or more fields which straddle two or more walls which divide said adjoining pressure generating rooms, and said two or more pressure generating rooms.

Claim 11] Said crevice for bosselation formed in said 2nd page of said metal plate is an ink jet recording head according to claim 8 characterized by being formed in the single field corresponding to said two or more whole pressure generating rooms.

Claim 12] Said metal plate is an ink jet recording head given in claim 1 characterized by being formed with per-elasticity alloys, such as pure nickel, a 3 yuan alloy of zinc, aluminum, and copper, or lead, tin, a bismuth, c., thru/or any 1 term of 11.

Claim 13] It has the nozzle plate which drilled two or more nozzle orifices, and the reservoir which supplies ink to two or more pressure generating room and said two or more pressure generating rooms which are open for free passage to said two or more nozzle orifices through two or more ink feed hoppers. The passage formation substrate containing the 1st page which counters mutually, and the 2nd page, and the lid material which closes 1st page of said passage formation substrate, The constituted passage unit which carried out the laminating, and a pressure generating means to pressurize the ink inside said pressure generating room, A preparation and said two or more pressure generating rooms are formed as two or more crevices which can be set to said 1st page of said passage formation substrate. Said two or more ink feed hoppers are ink jet recording heads characterized by having further two or more feed hopper free passage holes which can be set to said 2nd page

said passage formation substrate, and which are formed as two or more crevices and open two or more of said ink feed hopper and said two or more pressure generating rooms for free passage.

Claim 14] Said ink feed hopper and said pressure generating room are an ink jet recording head according to claim 13 characterized by for parts overlapping in the direction which has estranged mutually in the thickness direction of said passage formation substrate, and intersects perpendicularly in said thickness direction, and forming said feed hopper free passage hole in the part which said ink feed hopper and said pressure generating room overlapped.

Claim 15] It has the nozzle plate which drilled two or more nozzle orifices, and the reservoir which supplies ink to two or more pressure generating room and said two or more pressure generating rooms which are open for free passage to said two or more nozzle orifices through two or more ink feed hoppers. The passage formation substrate containing the 1st page which counters mutually, and the 2nd page, and the lid material which closes said 1st page of said passage formation substrate. A laminating is carried out and it has the constituted passage slot and a pressure generating means to pressurize the ink inside said pressure generating room. Said passage formation substrate It has the 1st plate containing said 1st page, and the 2nd plate containing said 2nd page, and the laminating of said 1st plate and said 2nd plate is carried out mutually. Said 1st plate Two or more through tubes corresponding to a pressure generating room corresponding to each of two or more of said pressure generating rooms. Two or more penetration sections for ink feed hopper formation which open the through tube corresponding to a reservoir corresponding to said reservoir, and said two or more through tubes corresponding to a pressure generating room and said through tube corresponding to a reservoir for free passage, and form said two or more ink feed hoppers. Two or more crevices for pressure generating room formation which an application and said 2nd plate are connected [ each / of two or more of said through tubes corresponding to a pressure generating room ], and form said two or more pressure generating rooms. The ink jet recording head characterized by including the through tube for reservoir formation which is connected [ through tube / said / corresponding to a reservoir ], and forms said reservoir.

Claim 16] Said 2nd plate is formed of the metal plate containing the 3rd page which counters the 2nd page and said 2nd page. Said through tube for reservoir formation It is the ink jet recording head according to claim 1 which is the through tube by which penetration formation was carried out from said 2nd page to said 3rd page said metal plate, and is characterized by said two or more crevices for pressure generating room formation being two or more crevices formed in said 3rd page of said metal plate of press working of sheet metal.

Claim 17] The ink jet recording head according to claim 16 characterized by carrying out flat-surface finish of said 3rd page of said metal plate after said press working of sheet metal.

Claim 18] The ink jet recording head according to claim 16 or 17 characterized by forming the crevice for bosselation in said 2nd page of said metal plate by press working of sheet metal in order to form a ridge in said 2nd page of the circumference of said crevice used as said pressure generating room, in case said crevice which serves as said pressure generating room in said press working of sheet metal at said 3rd page of said metal plate formed.

Claim 19] Said crevice for bosselation formed in said 2nd page of said metal plate is an ink jet recording head according to claim 18 characterized by being formed in two or more fields corresponding to two or more walls which divide said adjoining pressure generating rooms.

Claim 20] Said crevice for bosselation formed in said 2nd page of said metal plate is an ink jet recording head according to claim 18 characterized by being formed in two or more fields which straddle two or more walls which divide said adjoining pressure generating rooms, and said two or more pressure generating rooms.

Claim 21] Said crevice for bosselation formed in said 2nd page of said metal plate is an ink jet recording head according to claim 18 characterized by being formed in the single field corresponding to said two or more whole pressure generating rooms.

Claim 22] Said metal plate is an ink jet recording head given in claim 16 characterized by being formed with per-elasticity alloys, such as pure nickel, a 3 yuan alloy of zinc, aluminum, and copper, or lead, tin, a bismuth, c., thru/or any 1 term of 21.

Claim 23] An ink SHINITTO recording head given in claim 1 characterized by drilling the nozzle free passage hole in the field corresponding to said nozzle orifice of the base of said pressure generating room thru/or any 1 term of 22.

Claim 24] It is an ink jet recording head given in claim 1 which said lid material is the elastic plate which consisted of fields corresponding to said two or more pressure generating rooms possible [ elastic deformation ], and is characterized by said pressure generating means being two or more piezoelectric transducers made to

transform said elastic plate thru/or any 1 term of 23.

Claim 25] It has the nozzle plate which drilled two or more nozzle orifices, and the reservoir which supplies ink to two or more pressure generating room and said two or more pressure generating rooms which are open for the passage to said two or more nozzle orifices through two or more ink feed hoppers. The passage formation substrate containing the 1st page which counters mutually, and the 2nd page, and the lid material which closes said 1st page of said passage formation substrate. A laminating is carried out and it has the constituted passage and a pressure generating means to pressurize the ink inside said pressure generating room. Said passage formation substrate The through tube which penetration formation is carried out from said 1st page to said 2nd page, and serves as said reservoir at the metal plate containing the 1st page and said said 2nd page. The ink jet recording head characterized by having two or more crevices which are formed in said 1st page of said metal plate, and serve as said two or more pressure generating rooms, and the crevice formed in said 2nd page of said metal plate.

Claim 26] Said crevice formed in said 2nd page of said metal plate is an ink jet recording head according to claim 25 characterized by being formed in two or more fields corresponding to two or more walls which divide said adjoining pressure generating rooms, respectively.

Claim 27] Said crevice formed in said 2nd page of said metal plate is an ink jet recording head according to claim 25 characterized by being formed in two or more fields which straddle two or more walls which divide said adjoining pressure generating rooms, and said two or more pressure generating rooms, respectively.

Claim 28] Said crevice formed in said 2nd page of said metal plate is an ink jet recording head according to claim 25 characterized by being formed in the single field corresponding to said two or more whole pressure generating rooms.

Claim 29] Said metal plate is an ink jet recording head given in claim 25 characterized by being formed with super-elasticity alloys, such as pure nickel, a 3 yuan alloy of zinc, aluminum, and copper, or lead, tin, a bismuth, etc., thru/or any 1 term of 28.

## DETAILED DESCRIPTION

## [Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the ink jet recording head which a pressure generating room is pressurized [recording head] with a pressure generating means, and makes an ink droplet breathe out from a nozzle orifice.

[0002]

[Description of the Prior Art] The volume of a pressure generating room is changed with a piezoelectric transducer, and an ink jet recording head forms in the same substrate the pressure generating room which each opens for free passage in an independent nozzle orifice and a common ink room plurality and seriate, makes ink evaporate by the heater element, and it is constituted so that an ink droplet may be made to breathe out from a nozzle orifice.

[0003] Since it is necessary to form regularly in the pitch corresponding to recording density, the pressure generating room in such an ink jet recording head is formed by etching a substrate and carrying out injection molding of the polymeric materials.

[0004]

[Problem(s) to be Solved by the Invention] however, the anisotropic etching using the silicon single crystal as a substrate ingredient when it was going to secure etching precision — not depending — it does not obtain but there is a problem that ingredient cost goes up.

[0005] Moreover, since the rigidity of polymeric materials of what can form a pressure generating room in a high precision comparatively easily is low according to injection molding, there are problems — it is easy to cause degradation by the thermo cycle accompanying fatigue by the external force by the piezoelectric transducer and generation of heat of a heater element.

[0006] It is offering the ink jet recording head which this invention's can be made in view of such a problem, and the place made into the purpose can maintain endurance, and can aim at reduction of a manufacturing cost.

[0007]

[Means for Solving the Problem] In order to solve such a problem, the ink jet recording head by the 1st invention It has the nozzle plate which drilled two or more nozzle orifices, and the reservoir which supplies ink to two or more pressure generating room and said two or more pressure generating rooms which are open for free passage to said two or more nozzle orifices through two or more ink feed hoppers. The passage formation substrate containing the 1st page which counters mutually, and the 2nd page, and the lid material which closes said 1st page of said passage formation substrate, A laminating is carried out and it has the constituted passage unit and a pressure generating means to pressurize the ink inside said pressure generating room. Said passage formation substrate Penetration formation of the through tube which serves as said reservoir at the metal plate containing the 1st page and said said 2nd page is carried out from said 1st page to said 2nd page, and it is characterized by forming two or more crevices which serve as said two or more pressure generating rooms at said 1st page of said metal plate by press working of sheet metal, and being constituted.

[0008] Moreover, flat-surface finish of said 1st page of said metal plate is preferably carried out after said press working of sheet metal.

[0009] Moreover, two or more crevices used as said two or more ink feed hoppers are preferably formed in two or more of said crevices and coincidence used as said two or more pressure generating rooms of said press working of sheet metal.

[0010] Moreover, both said pressure generating room and said ink feed hopper are preferably formed in said 1st page of said metal plate.

[0011] Moreover, said crevice which forms said ink feed hopper is formed preferably more shallowly than said crevice which forms said pressure generating room.

[0012] Moreover, preferably, said pressure generating room is formed in said 1st page of said metal plate, and said ink feed hopper is formed in said 2nd page of said metal plate, and has further the feed hopper free passage hole which opens said pressure generating room and said ink feed hopper for free passage.

[0013] Moreover, flat-surface finish of both sides of said metal plate is preferably carried out

after said press working of sheet metal.

[0014] Moreover, in case said crevice which serves as said pressure generating room in said press working of sheet metal at said 1st page of said metal plate is formed preferably, in order to form a ridge in said 1st page of the circumference of said crevice used as said pressure generating room, the crevice for bosselation is formed in said 2nd page of said metal plate by press working of sheet metal.

[0015] Moreover, said crevice for bosselation formed in said 2nd page of said metal plate is preferably formed in two or more fields corresponding to two or more walls which divide said adjoining pressure generating rooms.

[0016] Moreover, said crevice for bosselation formed in said 2nd page of said metal plate is preferably formed in two or more fields which straddle two or more walls which divide said adjoining pressure generating rooms, and said two or more pressure generating rooms.

[0017] Moreover, said crevice for bosselation formed in said 2nd page of said metal plate is preferably formed in the single field corresponding to said two or more whole pressure generating rooms.

[0018] Moreover, said metal plate is preferably formed with super-elasticity alloys, such as pure nickel, a 3 yuan alloy of zinc, aluminum, and copper, or lead, tin, a bismuth, etc.

[0019] The ink jet recording head by the 2nd invention It has the nozzle plate which drilled two or more nozzle orifices, and the reservoir which supplies ink to two or more pressure generating room and said two or more pressure generating rooms which are open for free passage to said two or more nozzle orifices through two or more ink feed hoppers. The passage formation substrate containing the 1st page which counters mutually, and the 2nd page, and the lid material which closes said 1st page of said passage formation substrate, The constituted passage unit which carried out the laminating, and a pressure generating means to pressurize the ink inside said pressure generating room, A preparation and said two or more pressure generating rooms are formed as two or more crevices which can be set to said 1st page of said passage formation substrate. It is characterized by said two or more ink feed hoppers having further two or more feed hopper free passage holes which can be set to said 2nd page of said passage formation substrate and which are formed as two or more crevices and open two or more of said ink feed hopper and said two or more pressure generating rooms for free passage.

[0020] Moreover, preferably, parts overlap in the direction which has estranged mutually said ink feed hopper and said pressure generating room in the thickness direction of said passage formation substrate, and intersects perpendicularly in said thickness direction, and said feed hopper free passage hole is formed in the part which said ink feed hopper and said pressure generating room overlapped.

[0021] The ink jet recording head by the 3rd invention It has the nozzle plate which drilled two or more nozzle orifices, and the reservoir which supplies ink to two or more pressure generating room and said two or more pressure generating rooms which are open for free passage to said two or more nozzle orifices through two or more ink feed hoppers. The passage formation substrate containing the 1st page which counters mutually, and the 2nd page, and the lid material which closes said 1st page of said passage formation substrate, A laminating is carried out and it has the constituted passage unit and a pressure generating means to pressurize the ink inside said pressure generating room. Said passage formation substrate It has the 1st plate containing said 1st page, and the 2nd plate containing said 2nd page, and the laminating of said 1st plate and said 2nd plate is carried out mutually. Said 1st plate Two or more through tubes corresponding to a pressure generating room corresponding to each of two or more of said pressure generating rooms, Two or more penetration sections for ink feed hopper formation which open the through tube corresponding to a reservoir corresponding to said reservoir, and said two or more through tubes corresponding to a pressure generating room and said through tube corresponding to a reservoir for free passage, and form said two or more ink feed hoppers, An implication and said 2nd plate are characterized by including the through tube for reservoir formation which is connected [ each / of two or more of said through tubes corresponding to a pressure generating room ] by two or more crevices for pressure generating room formation which are connected and form said two or more pressure generating rooms, and said through tube corresponding to a reservoir, and forms said reservoir.

[0022] Said 2nd plate is preferably formed of the metal plate containing the 3rd page which

counters the 2nd page and said said 2nd page. Moreover, said through tube for reservoir formation It is the through tube by which penetration formation was carried out from said 2nd page to said 3rd page of said metal plate, and said two or more crevices for pressure generating room formation are two or more crevices formed in said 3rd page of said metal plate of press working of sheet metal.

[0023] Moreover, flat-surface finish of said 3rd page of said metal plate is preferably carried out after said press working of sheet metal.

[0024] Moreover, in case said crevice which serves as said pressure generating room in said press working of sheet metal at said 3rd page of said metal plate is formed preferably, in order to form a ridge in said 3rd page of the circumference of said crevice used as said pressure generating room, the crevice for bosselation is formed in said 2nd page of said metal plate by press working of sheet metal.

[0025] Moreover, said crevice for bosselation formed in said 2nd page of said metal plate is preferably formed in two or more fields corresponding to two or more walls which divide said adjoining pressure generating rooms.

[0026] Moreover, said crevice for bosselation formed in said 2nd page of said metal plate is preferably formed in two or more fields which straddle two or more walls which divide said adjoining pressure generating rooms, and said two or more pressure generating rooms.

[0027] Moreover, said crevice for bosselation formed in said 2nd page of said metal plate is preferably formed in the single field corresponding to said two or more whole pressure generating rooms.

[0028] Moreover, said metal plate is preferably formed with super-elasticity alloys, such as pure nickel, a 3 yuan alloy of zinc, aluminum, and copper, or lead, tin, a bismuth, etc.

[0029] Moreover, in the above 1st thru/or the 3rd invention, the nozzle free passage hole is preferably drilled in the field corresponding to said nozzle orifice of the base of said pressure generating room.

[0030] Moreover, in the above 1st thru/or the 3rd invention, preferably, said lid material is the elastic plate which consisted of fields corresponding to said two or more pressure generating rooms possible [ elastic deformation ], and said pressure generating means are two or more piezoelectric transducers made to transform said elastic plate.

[0031] The ink jet recording head by the 4th invention It has the nozzle plate which drilled two or more nozzle orifices, and the reservoir which supplies ink to two or more pressure generating room and said two or more pressure generating rooms which are open for free passage to said two or more nozzle orifices through two or more ink feed hoppers. The passage formation substrate containing the 1st page which counters mutually, and the 2nd page, and the lid material which closes said 1st page of said passage formation substrate, A laminating is carried out and it has the constituted passage unit and a pressure generating means to pressurize the ink inside said pressure generating room. Said passage formation substrate The through tube which penetration formation is carried out from said 1st page to said 2nd page, and serves as said reservoir at the metal plate containing the 1st page and said said 2nd page, It is characterized by having two or more crevices which are formed in said 1st page of said metal plate, and serve as said two or more pressure generating rooms, and the crevice formed in said 2nd page of said metal plate.

[0032] Moreover, said crevice formed in said 2nd page of said metal plate is preferably formed in two or more fields corresponding to two or more walls which divide said adjoining pressure generating rooms, respectively.

[0033] Moreover, said crevice formed in said 2nd page of said metal plate is preferably formed in two or more fields which straddle two or more walls which divide said adjoining pressure generating rooms, and said two or more pressure generating rooms, respectively.

[0034] Moreover, said crevice formed in said 2nd page of said metal plate is preferably formed in the single field corresponding to said two or more whole pressure generating rooms.

[0035] Moreover, said metal plate is preferably formed with super-elasticity alloys, such as pure nickel, a 3 yuan alloy of zinc, aluminum, and copper, or lead, tin, a bismuth, etc.

[0036]

[Embodiment of the Invention] The 1st operation gestalt of this invention is explained with reference to a drawing below the 1st operation gestalt.

[0037] Drawing 1 and drawing 2 are what shows the recording head by this operation gestalt, respectively. The passage unit 1 The nozzle plate 3 which drilled two or more nozzle orifices 2 at constant pitch, and the pressure generating room 5 which is open for free passage to a nozzle orifice 2 through the nozzle free passage hole 4 and the passage formation substrate 8 equipped with the reservoir 7 which supplies ink to this through the ink feed hopper 6, The laminating of the elastic plate (lid material) 11 to which contact at the tip of each piezoelectric transducer 10 in the longitudinal-oscillation mode of the piezo-electric oscillating unit 9 which is a pressure generating means, and expand and the volume of the pressure generating room 5 is made to reduce is carried out to one, and it is constituted.

[0038] In addition, although thin-walled part 11a is formed in the field which counters the pressure generating room 5 of an elastic plate 11 on the relation which used the piezoelectric transducer 10 as a pressure generating means and this operation gestalt is consisted of by the variation rate of a piezoelectric transducer 10 possible [ elastic deformation ], if it is in the recording head which makes ink evaporate by the heater element and generates a pressure, constituting as the rigid body is desirable.

[0039] The passage unit 1 is formed in the effective area 13 of the electrode holder 12 constituted by injection molding of polymeric materials etc., and the piezo-electric oscillating unit 9 is held in the hold room 15 of an electrode holder 12, after connecting with the flexible cable 14 which transmits the driving signal from the outside, a contact side with an electrode holder 12 is fixed with adhesives, respectively, the frame 16 which serves as electrostatic shield material to a nozzle plate side is put, and the recording head is constituted.

[0040] Drawing 3 is the decomposition perspective view of the passage unit 1. The passage formation substrate 8 Into the ingredient equipped with a super-elasticity-property and the endurance over ink, for example, a pure nickel plate [ a little ] thicker than depth d of the pressure generating room 5 which should be formed A through tube is beforehand formed in the field used as a reservoir 7, and the crevice which serves as the ink feed hopper 6 at a reservoir 7 side, and the crevice which is open for free passage to this, and serves as the pressure generating room 5 are formed, and the nozzle free passage hole 4 is drilled in the field which counters the nozzle orifice 2 of the pressure generating room 5 with laser etc., and it is constituted.

[0041] Thus, the constituted passage formation substrate 8 carries out alignment of the nozzle orifice 2, it fixes an elastic plate 11 to the field by the side of 2nd page 8b, i.e., opening, with adhesives etc. again, and a nozzle plate 3 is constituted so that it may be open for free passage to the nozzle free passage hole 4 of the field by the side of onethof them 8a, i.e., the closure.

[0042] Next, the manufacture approach of the above-mentioned passage formation substrate 8 is explained with reference to drawing 4 thru/or drawing 7.

[0043] First, in the 1st process shown in drawing 6 (I), the plate 21 which drilled the through tube 20 in the location which should form a reservoir 7 beforehand as shown in drawing 4 is prepared.

[0044] Next, in the 2nd process shown in drawing 6 (II-1, II-2), with the 1st metal mold 24 shown in drawing 5 (a), and the 2nd metal mold 26 shown in drawing 5 (b), as shown in drawing 7 (I), press working of sheet metal of the plate 21 is carried out. Here, the 1st metal mold 24 is equipped with two or more heights 25 which it has two or more heights 22 and 23 corresponding to the crevice used as the pressure generating room 5 and the ink feed hopper 6, and the 2nd metal mold 26 corresponds to wall 5a which divides the pressure generating room 5, and are located between the nozzle free passage hole 4 and the ink feed hopper 6. Moreover, heights 22 are formed so that the height h1 may become large a little rather than depth d of the pressure generating room 5 which should be formed.

[0045] Of this press process, two or more crevices 27 and 28 used as the pressure generating room 5 and the ink feed hopper 6 are formed by the heights 22 and 23 of the 1st metal mold 24, and two or more crevices (crevice for bosselation) 30 are formed in the field corresponding to septum 5a located among pressure generating room 5 comrades by the heights 25 of the 2nd metal mold 26. By this, as shown in drawing 6 (II-1, II-2) and drawing 7 (I), a part for heights 25 to have extruded from the rear face of a plate 21 will form the climax section in the field 29 of septum 5a located between the pressure generating rooms 5 a little. Thus, by forming a crevice 30 in a rear face, a becoming bored lump of the boundary section accompanying formation of the

heights 22 of the 1st metal mold 24 can be prevented.

[0046] Subsequently, in the 3rd process shown in drawing 6 (III), the field 29 of the front face by the side of opening of a plate 21 equivalent to 1st page 8a of the passage formation substrate 8 is flatness--ization--processed by rubbing etc. Then, the boundary of the crevice 27 which serves as the pressure generating room 5 as shown in drawing 7 (II) is flattened. From the first, by forming the climax section only in the field 29 of septum 5a between pressure generating room 5 comrades, since there is little volume, polish etc. can remove easily and 1st page 8a by the side of a crevice 27 and 28 is orthopedically operated at a flat surface.

[0047] Finally, the through-hole 31 which turns into the nozzle free passage hole 4 with pore formation techniques, such as an exposure of a laser beam, is drilled in the field which counters with a nozzle orifice 2 in the 4th process shown in drawing 6 (IV).

[0048] Thus, adhesives are applied to each front face of the formed passage formation substrate 8, and the passage unit 1 completes the elastic plate 11 which infixes a heat joining film and serves as a nozzle plate 3 and lid material a laminating and by equipping.

[0049] And since the nozzle free passage hole 4 is located in a non-press-working-of-sheet-metal field, it can be made positive adhesion is not only to attain, but to open for free passage certainly with a nozzle orifice 2, since the flat side is made near the boundary of the crevice 27 used as the pressure generating room 5 by polish.

[0050] In addition, although the crevice 30 is formed in the field 29 which is in agreement with septum 5a of the pressure generating room 5 in an above-mentioned operation gestalt As the 1st modification of the manufacture approach of the recording head by this operation gestalt As shown in drawing 8 , even if it forms crevice 30' in the field by the side of the crevice 28 of the ink feed hopper 6 so that a crevice 27 may be straddled from the field corresponding to septum 5a (refer to drawing 3 ), the same operation is done so rather than the field which forms the through-hole 31 used as the nozzle free passage hole 4 of the crevice 27 used as the pressure generating room 5.

[0051] Moreover, drawing 9 shows the 2nd modification of the manufacture approach of the recording head by this operation gestalt, and sets it to this manufacture approach. As the plate 21 in which the through tube 20 was formed in the location which should form a reservoir 7 beforehand like the above-mentioned manufacture approach is prepared ( drawing 9 (I) ) and it was shown in drawing 10 (a) As it was indicated in drawing 10 (b) as the 1st same metal mold 24 as the above-mentioned equipped with two or more heights 22 and 23 corresponding to the pressure generating room 5 and the crevice used as the ink feed hopper 6 a nozzle -- a free passage -- a hole -- four -- ink -- a feed hopper -- six -- between -- being located -- plurality -- a pressure -- generating -- a room -- five -- formation -- a field -- the whole -- it can cover -- being single -- heights -- 25 -- ' -- having had -- the -- two -- metal mold -- 26 -- ' -- press working of sheet metal -- carrying out .

[0052] This heights 25' is set as extent in which that height h3 ( drawing 10 (b) ) can form the pars basilaris ossis occipitalis of the pressure generating room 5 smaller than the height h2 of the heights 25 of the metal mold 26 in the above-mentioned manufacture approach.

[0053] Of this press process, the single crevice 32 is formed in the whole formation field of two or more pressure generating rooms 5 for two or more crevices 27 and 28 which serve as the pressure generating room 5 and the ink feed hopper 6 by the heights 22 and 23 of the 1st metal mold 24 by heights 25 of 2nd metal mold 26" again. By this, as shown in drawing 9 (II-1, II-2) and drawing 11 (I), a part for heights 25' to have extruded from the rear face will form the climax section in the field 29 used as septum 5a located between crevices 27 a little.

[0054] Also in this manufacture approach, a becoming bored lump of the boundary section accompanying formation of the heights 22 of the 1st metal mold 24 can be prevented with the meat extruded by the crevice 32 of 2nd page 8b like the above-mentioned manufacture approach.

[0055] Subsequently, as shown in drawing 9 (III) and drawing 11 (II), after flatness--izing a field 29 for the front face by the side of 1st page 8a of a plate 21, i.e., opening, by rubbing etc., as shown in drawing 9 (IV), the through-hole 31 used as the nozzle free passage hole 4 is drilled in a nozzle orifice 2 and the field which counters.

[0056] In addition, in an above-mentioned operation gestalt and its modification, although pure nickel is used as a plate 21 of the passage formation substrate 8, even if it uses the plate which

consists, for example of the 3 yuan alloy of zinc, aluminum, and copper, and super-elasticity alloys, such as lead, tin, and a bismuth, the same operation is done so.

[0057] The ink jet recording head by the 2nd operation gestalt, next the 2nd operation gestalt of this invention is explained with reference to drawing 12 and drawing 13. In addition, about the part which is common in the above-mentioned 1st operation gestalt, while attaching the same sign, detailed explanation is omitted.

[0058] As for the ink jet recording head by this operation gestalt, the structure of the passage formation substrate 40 is different from the above-mentioned 1st operation gestalt in part. Specifically in the passage formation substrate 40 of this operation gestalt, two or more crevices which form two or more ink feed hoppers 41 are formed in the 2nd page 40b [ not 1st page 40a of the passage formation substrate 40 but ] side (opening side of the pressure generating room 5) (side in which the nozzle plate 3 was attached) of the passage formation substrate 40.

[0059] Moreover, parts overlap in the direction which has estranged mutually each ink feed hopper 41 and each pressure generating room 5 in the thickness direction of the passage formation substrate 40, and intersects perpendicularly in the thickness direction. And each feed hopper free passage hole 42 is formed in the thickness direction at the part which each ink feed hopper 41 and each pressure generating room 5 overlapped, and each ink feed hopper 41 and each pressure generating room 5 are opened for free passage with each feed hopper free passage hole 42. Thus, with each ink feed hopper 41 and each feed hopper free passage hole 42, a reservoir 7 and each pressure generating room 5 are made to open for free passage, and supply of ink in each pressure generating room 5 from a reservoir 7 is enabled.

[0060] Next, the manufacture approach of the ink jet recording head by this operation gestalt is explained with reference to drawing 13.

[0061] Also in the manufacture approach in this operation gestalt, as shown in drawing 4, press working of sheet metal is carried out from the both sides like the above-mentioned 1st operation gestalt using the metal mold of a pair to the plate 21 which drilled the through tube 20 in the location which should form a reservoir 7 beforehand, and flattening processing is carried out to both sides after an appropriate time.

[0062] Drawing 13 (a) and (b) show the 1st metal mold 43 and 2nd metal mold 44 which are used by the manufacture approach in this operation gestalt. The 1st metal mold 43 is equipped with two or more heights 45 for forming two or more pressure generating rooms 5 so that drawing 13 (a) may show. However, the 1st metal mold 43 is not equipped with the thing equivalent to the heights 23 of the 1st metal mold 24 used by the manufacture approach in the 1st operation gestalt shown in drawing 5 (a).

[0063] Moreover, the 2nd metal mold 44 is equipped with two or more heights 46 for forming two or more ink feed hoppers 41 so that drawing 13 (b) may show. In addition, although this 2nd metal mold 44 is not equipped with the heights 25 shown in drawing 5 (b), it can also form suitably heights 46 and the heights which have the same function as heights 25 at the field in which it does not interfere.

[0064] And two or more crevices which form two or more pressure generating rooms 5, and two or more crevices which form two or more ink feed hoppers 41 are formed in coincidence by carrying out press working of sheet metal of the plate 21 from the both sides using the 1st metal mold 43 and 2nd metal mold 44. If press working of sheet metal is completed, flattening processing of both sides of a plate 21 will be carried out.

[0065] Thus, in this operation gestalt, since the crevice for forming the crevice for forming the pressure generating room 5 in 1st page 40a of the passage formation substrate 40, and forming the ink feed hopper 41 was formed in 2nd page 40b of the passage formation substrate 40, it is not necessary to form in one field at coincidence the crevice where the depth differs.

[0066] That is, in the above-mentioned 1st operation gestalt, the height of heights 22 and heights 23 differs so that it may turn out that the 1st metal mold 24 shown in drawing 5 R> 5 (a) is seen. This is because it is necessary to make the cross section of the ink feed hopper 6 smaller than the cross section of the pressure generating room 5 in order to make the back flow of the ink at the time of pressurizing the ink in the pressure generating room 5 into the minimum. On the other hand, in order to lower the resistance at the time of supply of ink and to raise responsibility about the pressure generating room 5, there is a demand of wanting to

enlarge the cross section (deeply).

[0067] However, if the part from which height differs in one mold is formed, it may become difficult to take out the precision of press working of sheet metal. Although it will be necessary to narrow width of face of the heights 23 for ink feed hopper 6 if the height of heights 22 and heights 23 is arranged in order to take out the precision of press working of sheet metal, narrowing width of face of heights 23 will also make difficult highly precise press working of sheet metal.

[0068] On the other hand, in this operation gestalt, since the pressure generating room 5 and the ink feed hopper 41 have been arranged to the field where the passage formation substrates 40 differ mutually, it is not necessary to form the part from which height differs in one mold, and highly precise press working of sheet metal can be attained.

[0069] The ink jet recording head by the 3rd operation gestalt, next the 3rd operation gestalt of this invention is explained with reference to drawing 14. In addition, about the part which is common in the above-mentioned 1st operation gestalt, while attaching the same sign, detailed explanation is omitted.

[0070] As for the ink jet recording head by this operation gestalt, the structure of the passage formation substrate 50 is different from the above-mentioned 1st operation gestalt in part. As shown in drawing 14 (a), the passage formation substrate 50 of this operation gestalt carries out the laminating of the 1st plate 51 shown in drawing 14 (b), and the 2nd plate 52 shown in drawing 14 (c), and, specifically, is constituted.

[0071] And the 1st plate 51 opens two or more through tubes 53 corresponding to a pressure generating room corresponding to each of two or more pressure generating rooms 5, the through tube 54 corresponding to a reservoir corresponding to a reservoir 7, and two or more through tubes 53 and through tubes 54 corresponding to a reservoir corresponding to a pressure generating room for free passage, and contains two or more penetration sections 55 for ink feed hopper formation which form two or more ink feed hoppers 6.

[0072] Moreover, the 2nd plate 52 contains the through tube 57 for reservoir formation which is connected [ each / of two or more through tubes 53 corresponding to a pressure generating room ] by the through tube 54 corresponding to two or more crevices 56 for pressure generating room formation which are connected and form two or more pressure generating rooms 5, and a reservoir, and forms a reservoir 7. Moreover, the nozzle free passage hole 4 is formed in the location corresponding to a nozzle orifice 2 in the crevice 56 for pressure generating room formation of the 2nd plate 52.

[0073] Next, the manufacture approach of the ink jet recording head by this operation gestalt is explained.

[0074] In drawing 14 (a), (b), and (c), the top face of the 1st plate 51 is set to 1st page 51a, the inferior surface of tongue of the 2nd plate 52 is set to 2nd page 52a, the top face of the 2nd plate 52 is set to 3rd page 52b, and the inferior surface of tongue of the 1st plate 51 is set to 4th page 51b.

[0075] In case the 1st plate 51 is formed, each penetration 53 and 54 of a predetermined configuration and the penetration section 55 are formed by performing punching processing or etching processing to the metal plate containing 1st page 51a and 4th page 51b. Here, the thickness of the 1st plate 51 specifies the cross section of the ink feed hopper 6.

[0076] On the other hand, in case the 2nd plate 52 is formed, to the metal plate containing 2nd page 52a and 3rd page 52b, the hole of the predetermined configuration penetrated from 2nd page 52a to 3rd page 52b is formed, and the through tube 54 for reservoir formation is formed.

[0077] Moreover, in case the crevice 56 for pressure generating room formation is formed in the 2nd plate 52, the crevice 56 for pressure generating room formation is formed by carrying out press working of sheet metal to 3rd page 52b, and forming the crevice of a predetermined configuration. After carrying out this press working of sheet metal, flattening processing of the 3rd page 52b of a metal plate is carried out by rubbing etc.

[0078] After an appropriate time, the nozzle free passage hole 4 is drilled in the field which counters the nozzle orifice 2 of the pressure generating room 5 with laser etc., and it forms in it.

[0079] Since according to this operation gestalt the laminating of the 1st plate 51 containing the ink feed hopper 6 formed of the penetration section 55 and the 2nd plate 52 including the

pressure generating room 5 formed of the crevice is carried out and the passage formation substrate 50 was constituted as stated above. The dimension of the cross section of the ink feed hopper 6 is prescribed by the thickness of the 1st plate 51, and the width of face of the penetration section 55, and, thereby, can form the cross section of the ink feed hopper 6 in a desired dimension correctly.

[0080] Moreover, since the pressure generating room 5 was formed by press working of sheet metal, it can form in the dimension of a request of the pressure generating room 5 correctly.

[0081]

[Effect of the Invention] Since the through tube which serves as a reservoir at a metal plate is formed in this invention as explained above, the crevice used as a pressure generating room is formed by press working of sheet metal and the passage formation substrate is constituted, the pressure generating room of the passage formation substrate which has big effect on the discharging performance of ink can be correctly formed in a desired dimension.

[0082] Since it is not necessary to form the part from which height differs in one mold while being able to form a pressure generating room and an ink feed hopper in coincidence from carrying out press working of sheet metal of the metal plate using the mold of a pair, since the pressure generating room and the ink feed hopper have been arranged to a field different mutually [ a passage formation substrate ] according to this invention, highly precise press working of sheet metal can be attained.

[0083] Since according to this invention the laminating of the 1st plate containing the ink feed hopper formed of the penetration section and the 2nd plate including the pressure generating room formed of the crevice is carried out and the passage formation substrate was constituted, it can form in the dimension of a request of the cross section of an ink feed hopper correctly.

## DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The assembly perspective view showing the ink jet recording head by 1 operation gestalt of this invention.

[Drawing 2] Drawing showing the cross-section structure of the recording head shown in drawing 1.

[Drawing 3] The assembly perspective view having shown the passage unit shown in drawing 1.

[Drawing 4] The perspective view having shown an example of the plate used for the manufacture of a passage unit shown in drawing 1.

[Drawing 5] (a) and (b) — respectively — the 1st operation gestalt of this invention — the perspective view having shown an example of the 1st and 2nd metal mold which carries out press working of sheet metal of the plate which was and was shown in drawing 4.

[Drawing 6] (I) — or drawing having shown the processing process of a plate which showed (IV) in drawing 4 with the cross-section structure of the shaft orientations of a pressure generating room.

[Drawing 7] (I) and (II) are drawings having shown the processing process of a plate shown in drawing 4 with the cross-section structure of the successive installation direction of a pressure generating room.

[Drawing 8] Drawing having shown the cross-section structure of the plate in the middle of the manufacture in the 1st modification of the manufacture approach of the recording head shown in drawing 1.

[Drawing 9] Drawing (I) thru/or (IV) are drawing having shown the processing process of the plate in the 2nd modification of the manufacture approach of the recording head shown in drawing 1 with the cross-section structure of the shaft orientations of a pressure generating room.

[Drawing 10] (a) and (b) are the perspective view having shown the 1st and 2nd metal mold which carries out press working of sheet metal of the plate in the 2nd modification of the manufacture approach of the recording head shown in drawing 1, respectively.

[Drawing 11] (I) and (II) are drawing having shown the processing process of the plate in the 2nd modification of the manufacture approach of the recording head shown in drawing 1 with the cross-section structure of the successive installation direction of a pressure generating room.

[Drawing 12] For (a), (b) is the top view having shown the important section of the ink jet recording head by the 2nd operation gestalt of this invention, and the sectional view which met the A-A line of (a).

[Drawing 13] (a) and (b) — respectively — the 2nd operation gestalt of this invention — the perspective view having shown the 1st and 2nd metal mold which carries out press working of sheet metal of the substrate which was and was shown in drawing 4.

[Drawing 14] For the sectional view having shown the important section of the ink jet recording head by the 3rd operation gestalt of this invention, and (b), (c) is [ (a) ] the top view having shown the 1st plate, and the top view having shown the 2nd plate.

[Description of Notations]

1 Passage Unit

2 Nozzle Orifice

3 Nozzle Plate

4 Nozzle Free Passage Hole

5 Pressure Generating Room

6 41 Ink feed hopper

7 Reservoir

8, 40, 50 Passage formation substrate

8a, 40a The 1st page of a passage formation substrate

8b, 40b The 2nd page of a passage formation substrate

10 Piezoelectric Transducer

20 Through Tube Used as Reservoir

21 Metal Plate

42 Feed Hopper Free Passage Hole

51 1st Plate

51a The top face of the 1st plate (the 1st page)

51b The inferior surface of tongue of the 1st plate (the 4th page)

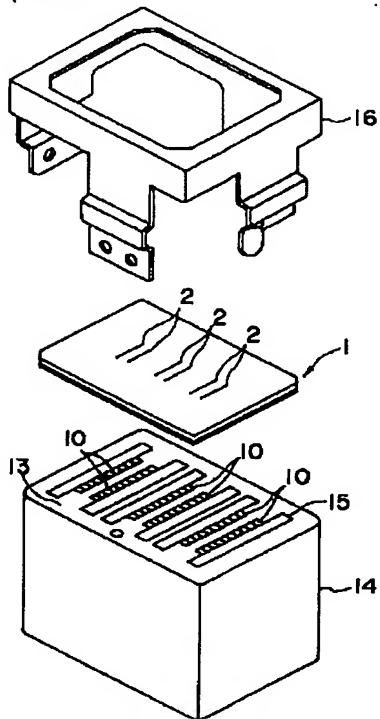
52 2nd Plate

52a The inferior surface of tongue of the 2nd plate (the 2nd page)

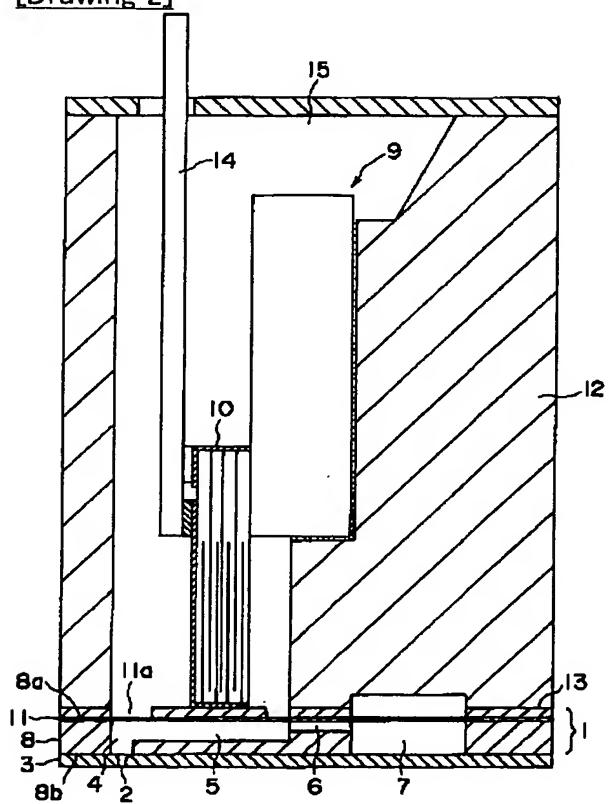
52b The top face of the 2nd plate (the 3rd page)

## DRAWINGS

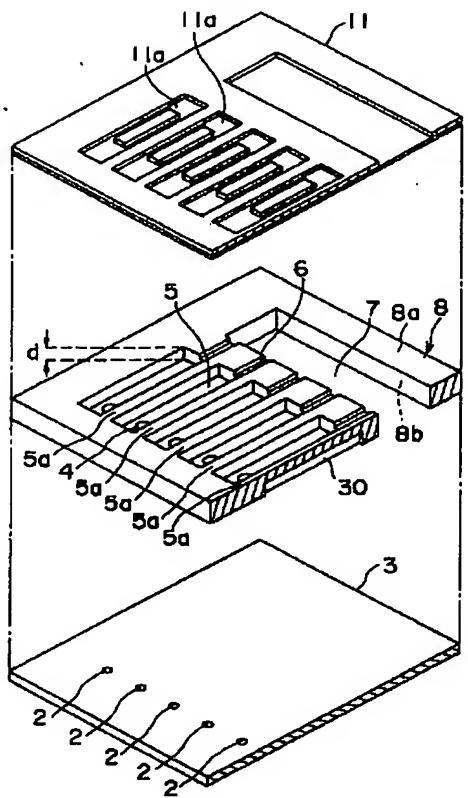
[Drawing 1]



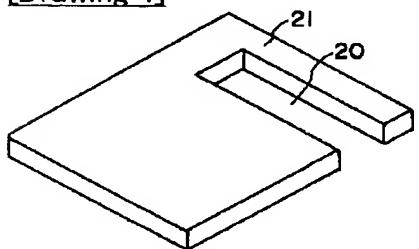
[Drawing 2]



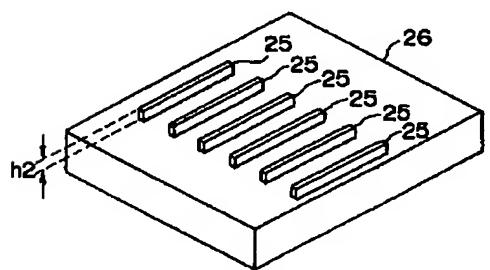
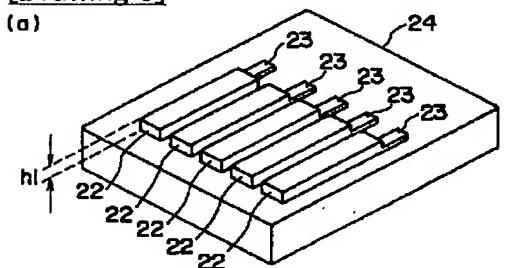
### [Drawing 3]



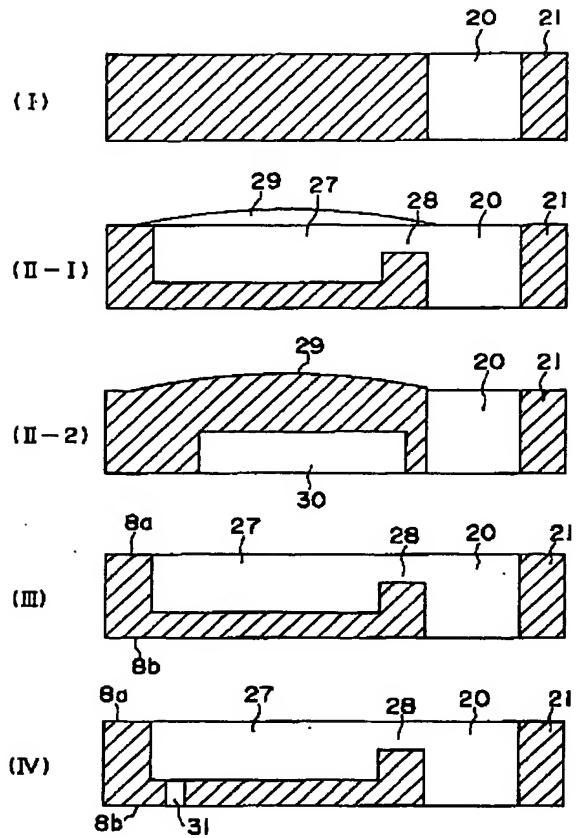
[Drawing 4]



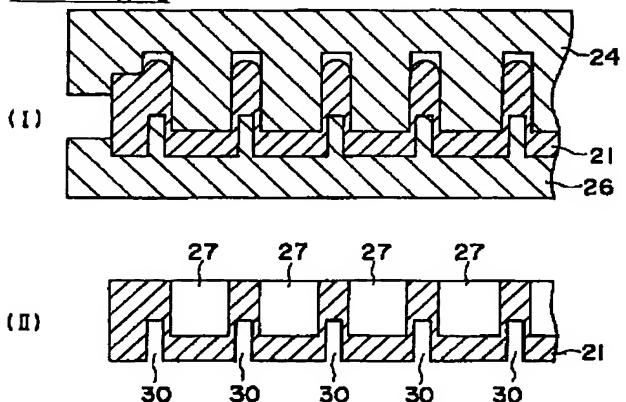
[Drawing 5]



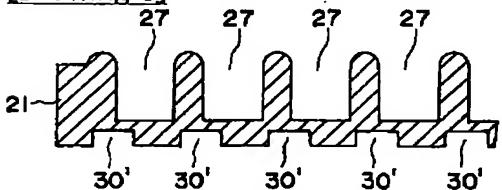
[Drawing 6]



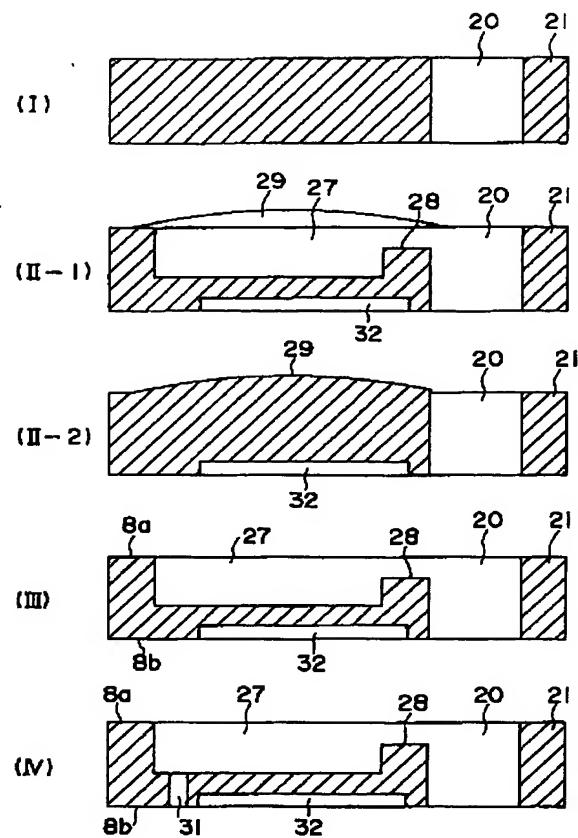
### [Drawing 7]



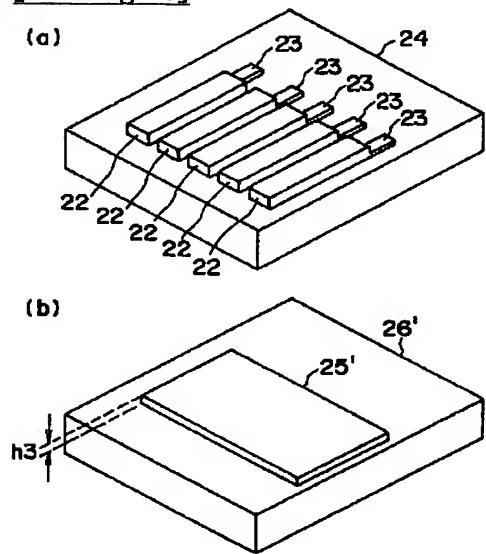
[Drawing 8]



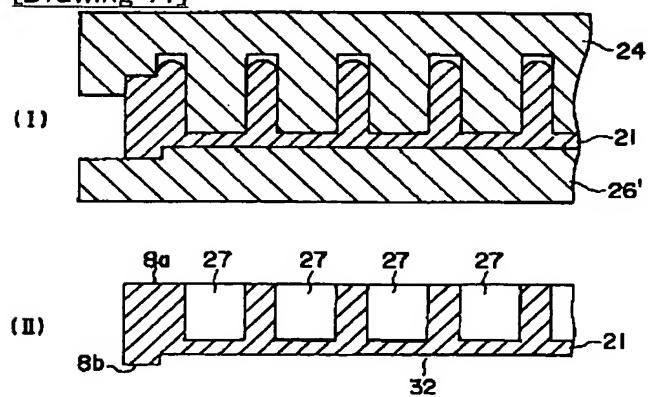
### [Drawing 9]



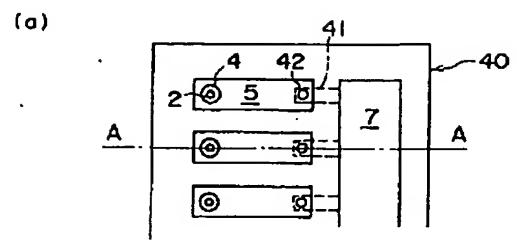
[Drawing 10]



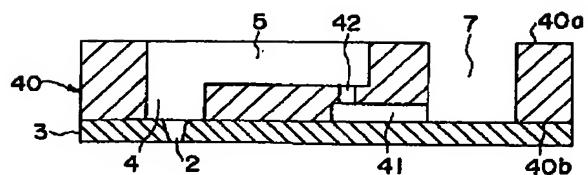
[Drawing 11]



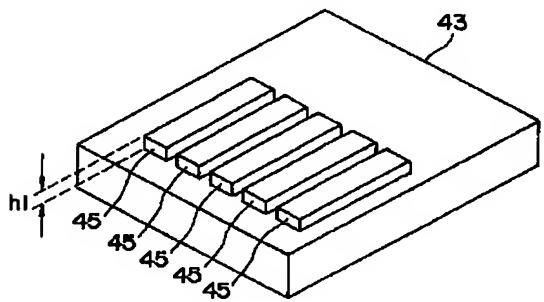
[Drawing 12]



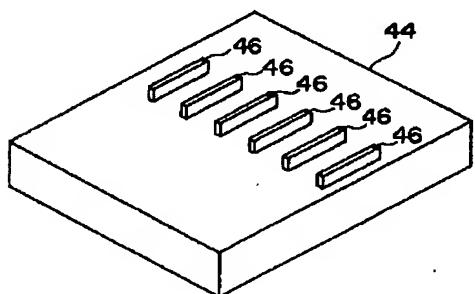
(b)



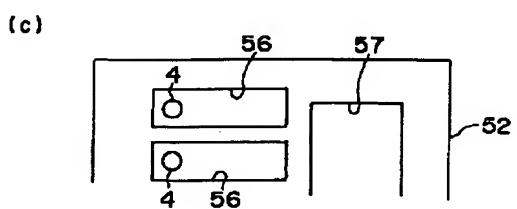
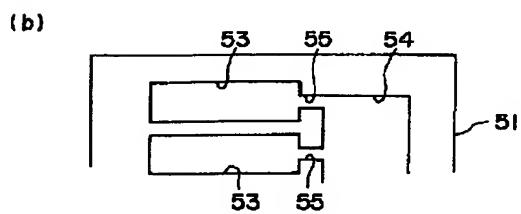
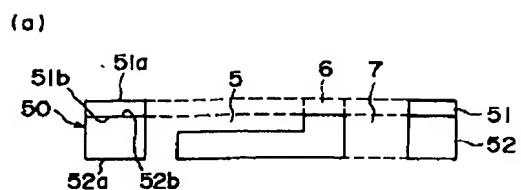
[Drawing 13]  
(g)



(b)



### [Drawing 14]



(19)日本国特許庁 (JP)

(12) 公開特許公報 (A)

(11)特許出願公開番号

特開2000-263799

(P2000-263799A)

(43)公開日 平成12年9月26日 (2000.9.26)

(51)Int.Cl.<sup>7</sup>

B 41 J 2/16  
2/045  
2/055

識別記号

F I

B 41 J 3/04

マーク\* (参考)

103H 2C057  
103A

審査請求 有 請求項の数29 OL (全12頁)

(21)出願番号 特願平11-340178

(22)出願日 平成11年11月30日 (1999.11.30)

(31)優先権主張番号 特願平11-4817

(32)優先日 平成11年1月12日 (1999.1.12)

(33)優先権主張国 日本 (JP)

(71)出願人 000002369

セイコーエプソン株式会社  
東京都新宿区西新宿2丁目4番1号

(72)発明者 高橋智明

長野県諏訪市大和三丁目3番5号 セイコ  
ーエプソン株式会社内

(72)発明者 碓井稔

長野県諏訪市大和三丁目3番5号 セイコ  
ーエプソン株式会社内

(74)代理人 100064285

弁理士 佐藤一雄 (外3名)

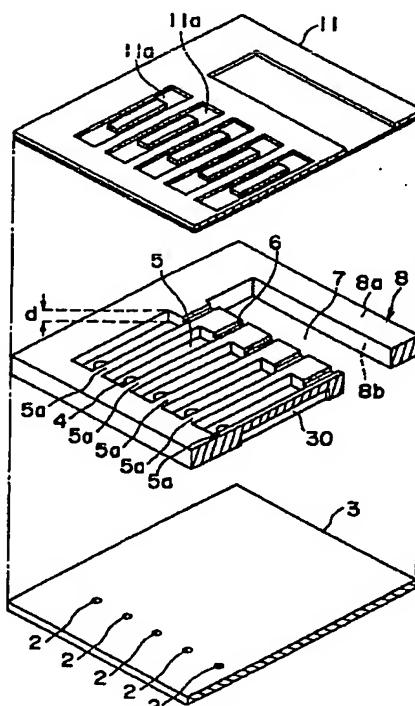
最終頁に続く

(54)【発明の名称】 インクジェット記録ヘッド

(57)【要約】

【課題】 耐久性を維持でき、かつ製造コストの低減を図ることができるインクジェット記録ヘッドを提供する。

【解決手段】 複数のノズル開口2を穿設したノズルプレート3と、複数のノズル開口2に連通する複数の圧力発生室5及び複数の圧力発生室5に複数のインク供給口6を介してインクを供給するリザーバ7を有し、互いに対向する第1面8a及び第2面8bを含む流路形成基板8と、流路形成基板8の第1面8aを封止する蓋材11と、を積層して流路ユニット1を構成する。圧力発生室5の内部のインクを加圧する圧電振動子10を設ける。第1面8a及び第2面8bを含む金属板材21にリザーバ7となる貫通孔20を第1面8aから第2面8bまで貫通形成し、金属板材21の第1面8aに、複数の圧力発生室5となる複数の凹部27をプレス加工により形成して流路形成基板8を構成する。



## 【特許請求の範囲】

【請求項1】複数のノズル開口を穿設したノズルプレートと、前記複数のノズル開口に連通する複数の圧力発生室及び前記複数の圧力発生室に複数のインク供給口を介してインクを供給するリザーバを有し、互いに対向する第1面及び第2面を含む流路形成基板と、前記流路形成基板の前記第1面を封止する蓋材と、を積層して構成した流路ユニットと、

前記圧力発生室の内部のインクを加圧する圧力発生手段と、を備え、

前記流路形成基板は、前記第1面及び前記第2面を含む金属板材に前記リザーバとなる貫通孔を前記第1面から前記第2面まで貫通形成し、前記金属板材の前記第1面上に、前記複数の圧力発生室となる複数の凹部をプレス加工により形成して構成されていることを特徴とするインクジェット記録ヘッド。

【請求項2】前記プレス加工の後に前記金属板材の前記第1面を平面仕上加工することを特徴とする請求項1記載のインクジェット記録ヘッド。

【請求項3】前記プレス加工によって、前記複数のインク供給口となる複数の凹部が、前記複数の圧力発生室となる前記複数の凹部と同時に形成されることを特徴とする請求項1又は2に記載のインクジェット記録ヘッド。

【請求項4】前記圧力発生室及び前記インク供給口は共に前記金属板材の前記第1面に形成されていることを特徴とする請求項3記載のインクジェット記録ヘッド。

【請求項5】前記インク供給口を形成する前記凹部は、前記圧力発生室を形成する前記凹部よりも浅く形成されていることを特徴とする請求項4記載のインクジェット記録ヘッド。

【請求項6】前記圧力発生室は前記金属板材の前記第1面上に形成され、前記インク供給口は前記金属板材の前記第2面上に形成されており、前記圧力発生室と前記インク供給口とを連通する供給口連通孔をさらに有することを特徴とする請求項3記載のインクジェット記録ヘッド。

【請求項7】前記プレス加工の後に前記金属板材の両面を平面仕上加工することを特徴とする請求項6記載のインクジェット記録ヘッド。

【請求項8】前記プレス加工において前記金属板材の前記第1面上に前記圧力発生室となる前記凹部を形成する際に、前記圧力発生室となる前記凹部の周辺の前記第1面上に隆起部を形成するために、前記金属板材の前記第2面上にプレス加工により隆起形成用凹部を形成することを特徴とする請求項1乃至7のいずれか一項に記載のインクジェット記録ヘッド。

【請求項9】前記金属板材の前記第2面上に形成される前記隆起形成用凹部は、隣接する前記圧力発生室同士を区画する複数の壁に対応する複数の領域に形成されることを特徴とする請求項8記載のインクジェット記録ヘッド。

【請求項10】前記金属板材の前記第2面上に形成される前記隆起形成用凹部は、隣接する前記圧力発生室同士を区画する複数の壁と前記複数の圧力発生室とにまたがる複数の領域に形成されることを特徴とする請求項8記載のインクジェット記録ヘッド。

【請求項11】前記金属板材の前記第2面上に形成される前記隆起形成用凹部は、前記複数の圧力発生室の全体に対応する単一の領域に形成されることを特徴とする請求項8記載のインクジェット記録ヘッド。

10 【請求項12】前記金属板材は、純ニッケル、亜鉛・アルミニウム・銅の3元合金、又は鉛・錫・ビスマス等の超塑性合金により形成されていることを特徴とする請求項1乃至11のいずれか一項に記載のインクジェット記録ヘッド。

【請求項13】複数のノズル開口を穿設したノズルプレートと、前記複数のノズル開口に連通する複数の圧力発生室及び前記複数の圧力発生室に複数のインク供給口を介してインクを供給するリザーバを有し、互いに対向する第1面及び第2面を含む流路形成基板と、前記流路形成基板の前記第1面を封止する蓋材と、を積層して構成した流路ユニットと、

前記圧力発生室の内部のインクを加圧する圧力発生手段と、を備え、  
前記複数の圧力発生室は前記流路形成基板の前記第1面上における複数の凹部として形成されており、  
前記複数のインク供給口は前記流路形成基板の前記第2面上における複数の凹部として形成されており、  
前記複数のインク供給口と前記複数の圧力発生室とを連通する複数の供給口連通孔をさらに有することを特徴とするインクジェット記録ヘッド。

【請求項14】前記インク供給口と前記圧力発生室とは、前記流路形成基板の厚み方向に互いに離間しており且つ前記厚み方向に直交する方向に一部が重なり合っており、前記供給口連通孔は前記インク供給口と前記圧力発生室とが重なり合った部分に形成されていることを特徴とする請求項13記載のインクジェット記録ヘッド。

【請求項15】複数のノズル開口を穿設したノズルプレートと、前記複数のノズル開口に連通する複数の圧力発生室及び前記複数の圧力発生室に複数のインク供給口を介してインクを供給するリザーバを有し、互いに対向する第1面及び第2面を含む流路形成基板と、前記流路形成基板の前記第1面を封止する蓋材と、を積層して構成した流路ユニットと、

前記圧力発生室の内部のインクを加圧する圧力発生手段と、を備え、  
前記流路形成基板は、前記第1面を含む第1板材と、前記第2面を含む第2板材と、を有し、前記第1板材と前記第2板材とは互いに積層されており、  
前記第1板材は、複数の前記圧力発生室のそれぞれに対応する複数の圧力発生室対応貫通孔と、前記リザーバに

50

対応するリザーバ対応貫通孔と、複数の前記圧力発生室対応貫通孔と前記リザーバ対応貫通孔とを連通し、前記複数のインク供給口を形成する複数のインク供給口形成用貫通部と、を含み、

前記第2板材は、複数の前記圧力発生室対応貫通孔のそれぞれに連接されて前記複数の圧力発生室を形成する複数の圧力発生室形成用凹部と、前記リザーバ対応貫通孔に連接されて前記リザーバを形成するリザーバ形成用貫通孔と、を含むことを特徴とするインクジェット記録ヘッド。

【請求項16】前記第2板材は、前記第2面及び前記第2面に対向する第3面を含む金属板材により形成されており、

前記リザーバ形成用貫通孔は、前記金属板材の前記第2面から前記第3面まで貫通形成された貫通孔であり、前記複数の圧力発生室形成用凹部は、前記金属板材の前記第3面にプレス加工により形成された複数の凹部であることを特徴とする請求項15記載のインクジェット記録ヘッド。

【請求項17】前記プレス加工の後に前記金属板材の前記第3面を平面仕上加工することを特徴とする請求項16記載のインクジェット記録ヘッド。

【請求項18】前記プレス加工において前記金属板材の前記第3面に前記圧力発生室となる前記凹部を形成する際に、前記圧力発生室となる前記凹部の周辺の前記第3面に隆起部を形成するために、前記金属板材の前記第2面にプレス加工により隆起形成用凹部を形成することを特徴とする請求項16又は17に記載のインクジェット記録ヘッド。

【請求項19】前記金属板材の前記第2面に形成される前記隆起形成用凹部は、隣接する前記圧力発生室同士を区画する複数の壁に対応する複数の領域に形成されることを特徴とする請求項18記載のインクジェット記録ヘッド。

【請求項20】前記金属板材の前記第2面に形成される前記隆起形成用凹部は、隣接する前記圧力発生室同士を区画する複数の壁と前記複数の圧力発生室とにまたがる複数の領域に形成されることを特徴とする請求項18記載のインクジェット記録ヘッド。

【請求項21】前記金属板材の前記第2面に形成される前記隆起形成用凹部は、前記複数の圧力発生室の全体に対応する单一の領域に形成されることを特徴とする請求項18記載のインクジェット記録ヘッド。

【請求項22】前記金属板材は、純ニッケル、亜鉛・アルミニウム・銅の3元合金、又は鉛・錫・ビスマス等の超塑性合金により形成されていることを特徴とする請求項16乃至21のいずれか一項に記載のインクジェット記録ヘッド。

【請求項23】前記圧力発生室の底面の前記ノズル開口に対応する領域にノズル連通孔が穿設されていることを

特徴とする請求項1乃至22のいずれか一項に記載のインクシニット記録ヘッド。

【請求項24】前記蓋材は、前記複数の圧力発生室に対応する領域で弾性変形可能に構成された弾性板であり、前記圧力発生手段は前記弾性板を変形させる複数の圧電振動子であることを特徴とする請求項1乃至23のいずれか一項に記載のインクジェット記録ヘッド。

【請求項25】複数のノズル開口を穿設したノズルプレートと、前記複数のノズル開口に連通する複数の圧力発生室及び前記複数の圧力発生室に複数のインク供給口を介してインクを供給するリザーバを有し、互いに対向する第1面及び第2面を含む流路形成基板と、前記流路形成基板の前記第1面を封止する蓋材と、を積層して構成した流路ユニットと、

前記圧力発生室の内部のインクを加圧する圧力発生手段と、を備え、

前記流路形成基板は、前記第1面及び前記第2面を含む金属板材に前記第1面から前記第2面まで貫通形成されて前記リザーバとなる貫通孔と、前記金属板材の前記第1面に形成されて前記複数の圧力発生室となる複数の凹部と、前記金属板材の前記第2面に形成された凹部と、を有することを特徴とするインクジェット記録ヘッド。

【請求項26】前記金属板材の前記第2面に形成された前記凹部は、隣接する前記圧力発生室同士を区画する複数の壁に対応する複数の領域にそれぞれ形成されていることを特徴とする請求項25記載のインクジェット記録ヘッド。

【請求項27】前記金属板材の前記第2面に形成された前記凹部は、隣接する前記圧力発生室同士を区画する複数の壁と前記複数の圧力発生室とにまたがる複数の領域にそれぞれ形成されていることを特徴とする請求項25記載のインクジェット記録ヘッド。

【請求項28】前記金属板材の前記第2面に形成された前記凹部は、前記複数の圧力発生室の全体に対応する单一の領域に形成されていることを特徴とする請求項25記載のインクジェット記録ヘッド。

【請求項29】前記金属板材は、純ニッケル、亜鉛・アルミニウム・銅の3元合金、又は鉛・錫・ビスマス等の超塑性合金により形成されていることを特徴とする請求項25乃至28のいずれか一項に記載のインクジェット記録ヘッド。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、圧力発生手段により圧力発生室を加圧してノズル開口からインク滴を吐出させるインクジェット記録ヘッドに関する。

【0002】

【従来の技術】インクジェット記録ヘッドは、それが独立のノズル開口と、共通のインク室とに連通する圧力発生室を、同一基板に複数、列状に形成し、圧力発生

室の容積を圧電振動子により変化させたり、また発熱素子によりインクを気化させてノズル開口からインク滴を吐出させるように構成されている。

【0003】このようなインクジェット記録ヘッドにおける圧力発生室は、記録密度に対応したピッチで規則的に形成する必要があるため、基板をエッチングしたり、また高分子材料を射出成形することにより形成されている。

#### 【0004】

【発明が解決しようとする課題】しかしながら、エッチング精度を確保しようとすると、基板材料としてシリコン単結晶を用いた異方性エッチングに頼らざるを得ず、材料コストが上昇するという問題がある。

【0005】また、射出成形によれば圧力発生室を比較的容易に高い精度で形成することができるものの、高分子材料の剛性が低いため、圧電振動子による外力による疲労や、発熱素子の発熱に伴うヒートサイクルにより劣化を来しやすい等の問題がある。

【0006】本発明はこのような問題に鑑みてなされたものであって、その目的とするところは、耐久性を維持でき、かつ製造コストの低減を図ることができるインクジェット記録ヘッドを提供することである。

#### 【0007】

【課題を解決するための手段】このような問題を解決するために第1の発明によるインクジェット記録ヘッドは、複数のノズル開口を穿設したノズルプレートと、前記複数のノズル開口に連通する複数の圧力発生室及び前記複数の圧力発生室に複数のインク供給口を介してインクを供給するリザーバを有し、互いに対向する第1面及び第2面を含む流路形成基板と、前記流路形成基板の前記第1面を封止する蓋材と、を積層して構成した流路ユニットと、前記圧力発生室の内部のインクを加圧する圧力発生手段と、を備え、前記流路形成基板は、前記第1面及び前記第2面を含む金属板材に前記リザーバとなる貫通孔を前記第1面から前記第2面まで貫通形成し、前記金属板材の前記第1面に、前記複数の圧力発生室となる複数の凹部をプレス加工により形成して構成されていることを特徴とする。

【0008】また、好ましくは、前記プレス加工の後に前記金属板材の前記第1面を平面仕上加工する。

【0009】また、好ましくは、前記プレス加工によって、前記複数のインク供給口となる複数の凹部が、前記複数の圧力発生室となる前記複数の凹部と同時に形成される。

【0010】また、好ましくは、前記圧力発生室及び前記インク供給口は共に前記金属板材の前記第1面に形成されている。

【0011】また、好ましくは、前記インク供給口を形成する前記凹部は、前記圧力発生室を形成する前記凹部よりも浅く形成されている。

【0012】また、好ましくは、前記圧力発生室は前記金属板材の前記第1面に形成され、前記インク供給口は前記金属板材の前記第2面に形成されており、前記圧力発生室と前記インク供給口とを連通する供給口連通孔をさらに有する。

【0013】また、好ましくは、前記プレス加工の後に前記金属板材の両面を平面仕上加工する。

【0014】また、好ましくは、前記プレス加工において前記金属板材の前記第1面に前記圧力発生室となる前記凹部を形成する際に、前記圧力発生室となる前記凹部の周辺の前記第1面に隆起部を形成するために、前記金属板材の前記第2面にプレス加工により隆起形成用凹部を形成する。

【0015】また、好ましくは、前記金属板材の前記第2面に形成される前記隆起形成用凹部は、隣接する前記圧力発生室同士を区画する複数の壁に対応する複数の領域に形成される。

【0016】また、好ましくは、前記金属板材の前記第2面に形成される前記隆起形成用凹部は、隣接する前記圧力発生室同士を区画する複数の壁と前記複数の圧力発生室とにまたがる複数の領域に形成される。

【0017】また、好ましくは、前記金属板材の前記第2面に形成される前記隆起形成用凹部は、前記複数の圧力発生室の全体に対応する单一の領域に形成される。

【0018】また、好ましくは、前記金属板材は、純ニッケル、亜鉛・アルミニウム・銅の3元合金、又は鉛・錫・ビスマス等の超塑性合金により形成されている。

【0019】第2の発明によるインクジェット記録ヘッドは、複数のノズル開口を穿設したノズルプレートと、前記複数のノズル開口に連通する複数の圧力発生室及び前記複数の圧力発生室に複数のインク供給口を介してインクを供給するリザーバを有し、互いに対向する第1面及び第2面を含む流路形成基板と、前記流路形成基板の前記第1面を封止する蓋材と、を積層して構成した流路ユニットと、前記圧力発生室の内部のインクを加圧する圧力発生手段と、を備え、前記複数の圧力発生室は前記流路形成基板の前記第1面における複数の凹部として形成されており、前記複数のインク供給口は前記流路形成基板の前記第2面における複数の凹部として形成されており、前記複数のインク供給口と前記複数の圧力発生室とを連通する複数の供給口連通孔をさらに有することを特徴とする。

【0020】また、好ましくは、前記インク供給口と前記圧力発生室とは、前記流路形成基板の厚み方向に互いに離間しており且つ前記厚み方向に直交する方向に一部が重なり合っており、前記供給口連通孔は前記インク供給口と前記圧力発生室とが重なり合った部分に形成されている。

【0021】第3の発明によるインクジェット記録ヘッドは、複数のノズル開口を穿設したノズルプレートと、

前記複数のノズル開口に連通する複数の圧力発生室及び前記複数の圧力発生室に複数のインク供給口を介してインクを供給するリザーバを有し、互いに対向する第1面及び第2面を含む流路形成基板と、前記流路形成基板の前記第1面を封止する蓋材と、を積層して構成した流路ユニットと、前記圧力発生室の内部のインクを加圧する圧力発生手段と、を備え、前記流路形成基板は、前記第1面を含む第1板材と、前記第2面を含む第2板材と、を有し、前記第1板材と前記第2板材とは互いに積層されており、前記第1板材は、複数の前記圧力発生室のそれに対応する複数の圧力発生室対応貫通孔と、前記リザーバに対応するリザーバ対応貫通孔と、複数の前記圧力発生室対応貫通孔と前記リザーバ対応貫通孔とを連通し、前記複数のインク供給口を形成する複数のインク供給口形成用貫通部と、を含み、前記第2板材は、複数の前記圧力発生室対応貫通孔のそれぞれに連接されて前記複数の圧力発生室を形成する複数の圧力発生室形成用凹部と、前記リザーバ対応貫通孔に連接されて前記リザーバを形成するリザーバ形成用貫通孔と、を含むことを特徴とする。

【0022】また、好ましくは、前記第2板材は、前記第2面及び前記第2面に対向する第3面を含む金属板材により形成されており、前記リザーバ形成用貫通孔は、前記金属板材の前記第2面から前記第3面まで貫通形成された貫通孔であり、前記複数の圧力発生室形成用凹部は、前記金属板材の前記第3面にプレス加工により形成された複数の凹部である。

【0023】また、好ましくは、前記プレス加工の後に前記金属板材の前記第3面を平面仕上加工する。

【0024】また、好ましくは、前記プレス加工において前記金属板材の前記第3面に前記圧力発生室となる前記凹部を形成する際に、前記圧力発生室となる前記凹部の周辺の前記第3面に隆起部を形成するために、前記金属板材の前記第2面にプレス加工により隆起形成用凹部を形成する。

【0025】また、好ましくは、前記金属板材の前記第2面に形成される前記隆起形成用凹部は、隣接する前記圧力発生室同士を区画する複数の壁に対応する複数の領域に形成される。

【0026】また、好ましくは、前記金属板材の前記第2面に形成される前記隆起形成用凹部は、隣接する前記圧力発生室同士を区画する複数の壁と前記複数の圧力発生室とにまたがる複数の領域に形成される。

【0027】また、好ましくは、前記金属板材の前記第2面に形成される前記隆起形成用凹部は、前記複数の圧力発生室の全体に対応する单一の領域に形成される。

【0028】また、好ましくは、前記金属板材は、純ニッケル、亜鉛・アルミニウム・銅の3元合金、又は鉛・錫・ビスマス等の超塑性合金により形成されている。

【0029】また、上記第1乃至第3の発明において、

好ましくは、前記圧力発生室の底面の前記ノズル開口に対応する領域にノズル連通孔が穿設されている。

【0030】また、上記第1乃至第3の発明において、好ましくは、前記蓋材は、前記複数の圧力発生室に対応する領域で弾性変形可能に構成された弾性板であり、前記圧力発生手段は前記弾性板を変形させる複数の圧電振動子である。

【0031】第4の発明によるインクジェット記録ヘッドは、複数のノズル開口を穿設したノズルプレートと、

10 前記複数のノズル開口に連通する複数の圧力発生室及び前記複数の圧力発生室に複数のインク供給口を介してインクを供給するリザーバを有し、互いに対向する第1面及び第2面を含む流路形成基板と、前記流路形成基板の前記第1面を封止する蓋材と、を積層して構成した流路ユニットと、前記圧力発生室の内部のインクを加圧する圧力発生手段と、を備え、前記流路形成基板は、前記第1面及び前記第2面を含む金属板材に前記第1面から前記第2面まで貫通形成されて前記リザーバとなる貫通孔と、前記金属板材の前記第1面に形成されて前記複数の圧力発生室となる複数の凹部と、前記金属板材の前記第2面に形成された凹部と、を有することを特徴とする。

【0032】また、好ましくは、前記金属板材の前記第2面に形成された前記凹部は、隣接する前記圧力発生室同士を区画する複数の壁に対応する複数の領域にそれぞれ形成されている。

【0033】また、好ましくは、前記金属板材の前記第2面に形成された前記凹部は、隣接する前記圧力発生室同士を区画する複数の壁と前記複数の圧力発生室とにまたがる複数の領域にそれぞれ形成されている。

【0034】また、好ましくは、前記金属板材の前記第2面に形成された前記凹部は、前記複数の圧力発生室の全体に対応する单一の領域に形成されている。

【0035】また、好ましくは、前記金属板材は、純ニッケル、亜鉛・アルミニウム・銅の3元合金、又は鉛・錫・ビスマス等の超塑性合金により形成されている。

【0036】

【発明の実施の形態】第1実施形態

以下、本発明の第1実施形態について図面を参照して説明する。

40 【0037】図1、図2は、それぞれ本実施形態による記録ヘッドを示すものであって、流路ユニット1は、複数のノズル開口2を一定ピッチで穿設したノズルプレート3と、ノズル連通孔4を介してノズル開口2に連通する圧力発生室5、これにインク供給口6を介してインクを供給するリザーバ7を備えた流路形成基板8と、圧力発生手段である圧電振動ユニット9の縦振動モードの各圧電振動子10の先端に当接して圧力発生室5の容積を膨張・縮小させる弾性板(蓋材)11とを一体に積層して構成されている。

【0038】なお、この実施形態では圧力発生手段とし

て圧電振動子10を使用した関係上、弾性板11の圧力発生室5に対向する領域に薄肉部11aを形成して、圧電振動子10の変位により弾性変形可能に構成されているが、発熱素子によりインクを気化させて圧力を発生させる記録ヘッドにあっては、剛体として構成するのが望ましい。

【0039】流路ユニット1は、高分子材料の射出成形等により構成されたホルダー12の開口面13に設けられ、また圧電振動ユニット9は外部からの駆動信号を伝達するフレキシブルケーブル14に接続された上でホルダー12の収容室15に収容され、それぞれホルダー12との当接面を接着剤により固定され、ノズルプレート側に静電シールド材を兼ねる枠体16を被せて記録ヘッドが構成されている。

【0040】図3は、流路ユニット1の分解斜視図であり、流路形成基板8は、超塑性的な特性と、インクに対する耐久性とを備えた材料、例えば形成すべき圧力発生室5の深さdよりも若干厚い純ニッケル板に、リザーバ7となる領域に予め貫通孔を形成し、リザーバ7側にインク供給口6となる凹部と、これに連通して圧力発生室5となる凹部を形成し、圧力発生室5のノズル開口2に對向する領域にレーザ等によりノズル連通孔4を穿設して構成されている。

【0041】このように構成された流路形成基板8は、その第1面8a、つまり封止側の面のノズル連通孔4に連通するようにノズル開口2を位置合わせてノズルプレート3を、また、その第2面8b、つまり開口側の面に弾性板11を接着剤等により固定して構成される。

【0042】次に、上述の流路形成基板8の製造方法について、図4乃至図7を参照して説明する。

【0043】まず、図6(I)に示した第1工程において、図4に示したように予めリザーバ7を形成すべき位置に貫通孔20を穿設した板材21を用意する。

【0044】次に、図6(II-1, II-2)に示した第2工程において、板材21を、図5(a)に示した第1の金型24と、図5(b)に示した第2の金型26とにより、図7(I)に示したようにプレス加工する。ここで、第1の金型24は圧力発生室5及びインク供給口6となる凹部に対応する複数の凸部22、23を備えており、第2の金型26は圧力発生室5を区画する壁5aに対応し、かつノズル連通孔4とインク供給口6との間に位置する複数の凸部25を備えている。また、凸部22は、その高さh1が、形成すべき圧力発生室5の深さdよりも若干大きくなるように形成されている。

【0045】このプレス工程により、第1の金型24の凸部22、23により、圧力発生室5及びインク供給口6となる複数の凹部27、28が形成され、また第2の金型26の凸部25により、圧力発生室5同士の間に位置する隔壁5aに対応する領域に複数の凹部(隆起形成用凹部)30を形成する。これにより、図6(II-1、

II-2)及び図7(I)に示したように、凸部25により板材21の裏面から押し出された分が圧力発生室5の間に位置する隔壁5aの領域29に、若干盛り上り部を形成することになる。このように裏面に凹部30を形成することにより、第1の金型24の凸部22の形成に伴う境界部のだれ込みを防止することができる。

【0046】次いで、図6(III)に示した第3工程において、流路形成基板8の第1面8aに相当する、板材21の開口側の表面の領域29をラビング等により平坦化処理する。すると、図7(II)に示したように圧力発生室5となる凹部27の境界が平面化される。もとより、盛り上がり部は、圧力発生室5同士の間の隔壁5aの領域29にのみ形成されていて体積が少ないので、研磨等により容易に除去でき、凹部27、28側の第1面8aが平面に整形される。

【0047】最後に、図6(IV)に示した第4工程において、ノズル開口2と対向する領域に、レーザ光の照射等の細孔形成技術によりノズル連通孔4となる通孔31を穿設する。

【0048】このようにして形成された流路形成基板8の各表面に接着剤を塗布したり、また熱溶着フィルムを介してノズルプレート3と蓋材となる弾性板11を積層、装着することにより流路ユニット1が完成する。

【0049】そして、圧力発生室5となる凹部27の境界近傍は、研磨により平坦面に仕上げられているので、確実な接着が可能となるばかりでなく、ノズル連通孔4が非プレス加工領域に位置しているため、ノズル開口2と確実に連通させることができる。

【0050】なお、上述の実施形態においては、圧力発生室5の隔壁5aに一致する領域29に凹部30を形成しているが、本実施形態による記録ヘッドの製造方法の第1変形例としては、図8に示したように、圧力発生室5となる凹部27の、ノズル連通孔4となる通孔31を形成する領域よりもインク供給口6の凹部28側の領域に、隔壁5a(図3参照)に対応する領域から凹部27にまたがるように凹部30'を形成しても同様の作用を奏する。

【0051】また、図9は、本実施形態による記録ヘッドの製造方法の第2変形例を示すものであって、この製造方法においては、前述の製造方法と同様に予めリザーバ7を形成すべき位置に貫通孔20を形成した板材21を用意し(図9(I))、図10(a)に示したように、圧力発生室5、及びインク供給口6となる凹部に対応する複数の凸部22、23を備えた前述と同様の第1の金型24と、図10(b)に示したように、ノズル連通孔4とインク供給口6との間に位置し、複数の圧力発生室5の形成領域の全体をカバーできる単一の凸部25'を備えた第2の金型26'によりプレス加工する。

【0052】この凸部25'は、その高さh3(図10

(b) ) が圧力発生室5の底部を形成できる程度に、前述の製造方法における金型26の凸部25の高さh2よりも小さく設定されている。

【0053】このプレス工程により、第1の金型24の凸部22、23により圧力発生室5及びインク供給口6となる複数の凹部27、28が、また第2の金型26'の凸部25'により複数の圧力発生室5の形成領域全体に単一の凹部32が形成される。これにより、図9 (II-1、II-2) 及び図11 (I) に示したように、凸部25'により裏面から押し出された分が凹部27の間に位置する隔壁5aとなる領域29に若干盛り上り部を形成することになる。

【0054】この製造方法においても、前述の製造方法と同様に、第2面8bの凹部32により押し出された肉により、第1の金型24の凸部22の形成に伴う境界部のだれ込みを防止することができる。

【0055】次いで、図9 (III) 及び図11 (II) に示したように、板材21の第1面8a、つまり開口側の表面をラビング等により領域29を平坦化してから、図9 (IV) に示したように、ノズル開口2と対向する領域にノズル連通孔4となる通孔31を穿設する。

【0056】なお、上述の実施形態及びその変形例においては、流路形成基板8の板材21として純ニッケルを使用しているが、例えば亜鉛・アルミニウム・銅の3元合金や、鉛・錫・ビスマス等の超塑性合金から成る板材を用いても同様の作用を奏する。

#### 【0057】第2実施形態

次に、本発明の第2実施形態によるインクジェット記録ヘッドについて図12及び図13を参照して説明する。

なお、上記第1実施形態と共通する部分については、同一符号を付すと共に詳細な説明は省略する。

【0058】本実施形態によるインクジェット記録ヘッドは、流路形成基板40の構造が上記第1実施形態と一部相違する。具体的には、本実施形態の流路形成基板40においては、複数のインク供給口41を形成する複数の凹部が、流路形成基板40の第1面40a側(圧力発生室5の開口側)ではなく、流路形成基板40の第2面40b側(ノズルプレート3が取り付けられた側)に形成されている。

【0059】また、各インク供給口41と各圧力発生室5とは、流路形成基板40の厚み方向に互いに離間しており且つ厚み方向に直交する方向に一部が重なり合っている。そして、各インク供給口41と各圧力発生室5とが重なり合った部分に各供給口連通孔42が厚み方向に形成されており、各供給口連通孔42によって各インク供給口41と各圧力発生室5とが連通されている。このように、各インク供給口41及び各供給口連通孔42によって、リザーバ7と各圧力発生室5とを連通させて、リザーバ7から各圧力発生室5へのインクの供給を可能としている。

【0060】次に、本実施形態によるインクジェット記録ヘッドの製造方法について図13を参照して説明する。

【0061】本実施形態における製造方法においても、上記第1実施形態と同様に、図4に示したように予めリザーバ7を形成すべき位置に貫通孔20を穿設した板材21に対して、一对の金型を用いてその両面からプレス加工し、かかる後に両面に対して平坦化処理を実施する。

10 【0062】図13 (a)、(b) は、本実施形態における製造方法で使用する第1の金型43及び第2の金型44を示している。図13 (a) から分かるように第1の金型43は、複数の圧力発生室5を形成するための複数の凸部45を備えている。ただし、第1の金型43は、図5 (a) に示した第1実施形態における製造方法で使用する第1の金型24の凸部23に相当するものを備えていない。

【0063】また、図13 (b) から分かるように第2の金型44は、複数のインク供給口41を形成するための複数の凸部46を備えている。なお、この第2の金型44は、図5 (b) に示した凸部25を備えていないが、凸部46と干渉しない領域に、凸部25と同様の機能を有する凸部を適宜形成することもできる。

【0064】そして、第1の金型43及び第2の金型44を用いて板材21をその両面からプレス加工することによって、複数の圧力発生室5を形成する複数の凹部と、複数のインク供給口41を形成する複数の凹部とが同時に形成されている。プレス加工が終了したら、板材21の両面を平坦化処理する。

【0065】このように本実施形態においては、圧力発生室5を形成するための凹部を流路形成基板40の第1面40aに形成し、インク供給口41を形成するための凹部を流路形成基板40の第2面40bに形成するようにしたので、1つの面に深さの異なる凹部を同時に形成する必要がない。

【0066】つまり、上記第1実施形態においては、図5 (a) に示した第1の金型24を見ると分かるように、凸部22と凸部23との高さが異なっている。これは、圧力発生室5内のインクを加圧した際のインクの逆流を最小限にするために、インク供給口6の断面積を圧力発生室5の断面積よりも小さくする必要があるからである。一方、圧力発生室5については、インクの供給時の抵抗を下げる応答性を高めるために、その断面積を大きく(深く)したいという要求がある。

【0067】ところが、1つの型に高さの異なる部分を形成すると、プレス加工の精度を出すことが困難になる場合がある。プレス加工の精度を出すために凸部22と凸部23の高さをそろえると、インク供給口6用の凸部23の幅を狭くする必要が生じるが、凸部23の幅を狭くすることもまた、高精度のプレス加工を困難なものに

してしまう。

【0068】これに対して本実施形態においては、圧力発生室5とインク供給口41とを、流路形成基板40の互いに異なる面に配置したので、1つの型に高さの異なる部分を形成する必要がなく、高精度のプレス加工を達成することができる。

#### 【0069】第3実施形態

次に、本発明の第3実施形態によるインクジェット記録ヘッドについて図14を参照して説明する。なお、上記第1実施形態と共通する部分については、同一符号を付すと共に詳細な説明は省略する。

【0070】本実施形態によるインクジェット記録ヘッドは、流路形成基板50の構造が上記第1実施形態と一部相違する。具体的には、本実施形態の流路形成基板50は、図14(a)に示したように、図14(b)に示した第1板材51と、図14(c)に示した第2板材52とを積層して構成されている。

【0071】そして、第1板材51は、複数の圧力発生室5のそれぞれに対応する複数の圧力発生室対応貫通孔53と、リザーバ7に対応するリザーバ対応貫通孔54と、複数の圧力発生室対応貫通孔53とリザーバ対応貫通孔54とを連通し、複数のインク供給口6を形成する複数のインク供給口形成用貫通部55と、を含んでいる。

【0072】また、第2板材52は、複数の圧力発生室対応貫通孔53のそれぞれに連接されて複数の圧力発生室5を形成する複数の圧力発生室形成用凹部56と、リザーバ対応貫通孔54に連接されてリザーバ7を形成するリザーバ形成用貫通孔57とを含んでいる。また、第2板材52の圧力発生室形成用凹部56には、ノズル開口2に対応する位置にノズル連通孔4が形成されている。

【0073】次に、本実施形態によるインクジェット記録ヘッドの製造方法について説明する。

【0074】図14(a)、(b)、(c)において、第1板材51の上面を第1面51aとし、第2板材52の下面を第2面52aとし、第2板材52の上面を第3面52bとし、第1板材51の下面を第4面51bとする。

【0075】第1板材51を形成する際には、第1面51a及び第4面51bを含む金属板材に対して、打ち抜き加工又はエッチング加工を行うことにより、所定形状の各貫通孔53、54、貫通部55を形成する。ここで、第1板材51の厚みは、インク供給口6の断面積を規定する。

【0076】一方、第2板材52を形成する際には、第2面52a及び第3面52bを含む金属板材に対して、第2面52aから第3面52bまで貫通する所定形状の孔を形成してリザーバ形成用貫通孔54を形成する。

【0077】また、第2板材52に圧力発生室形成用凹

部56を形成する際には、第3面52bに対してプレス加工を実施して所定形状の凹部を形成することにより、圧力発生室形成用凹部56を形成する。このプレス加工を実施した後、金属板材の第3面52bをラビング等により平坦化処理する。

【0078】しかる後、圧力発生室5のノズル開口2に対向する領域にレーザ等によりノズル連通孔4を穿設して形成する。

【0079】以上述べたように本実施形態によれば、貫通部55により形成されたインク供給口6を含む第1板材51と、凹部により形成された圧力発生室5を含む第2板材52とを積層して流路形成基板50を構成するようとしたので、インク供給口6の断面の寸法は第1板材51の厚さ及び貫通部55の幅により規定され、これにより、インク供給口6の断面を所望の寸法に正確に形成することができる。

【0080】また、圧力発生室5をプレス加工により形成するようにしたので、圧力発生室5を所望の寸法に正確に形成することができる。

#### 【0081】

【発明の効果】以上説明したように本発明においては、金属板材にリザーバとなる貫通孔を形成し、圧力発生室となる凹部をプレス加工により形成して流路形成基板が構成されているため、インクの吐出性能に大きな影響を及ぼす流路形成基板の圧力発生室を、所望の寸法に正確に形成することができる。

【0082】本発明によれば、圧力発生室とインク供給口とを、流路形成基板の互いに異なる面に配置したので、一対の型を用いて金属板材をプレス加工することより圧力発生室及びインク供給口を同時に形成できると共に、1つの型に高さの異なる部分を形成する必要がないので、高精度のプレス加工を達成することができる。

【0083】本発明によれば、貫通部により形成されたインク供給口を含む第1板材と、凹部により形成された圧力発生室を含む第2板材とを積層して流路形成基板を構成するようにしたので、インク供給口の断面を所望の寸法に正確に形成することができる。

#### 【図面の簡単な説明】

【図1】本発明の一実施形態によるインクジェット記録ヘッドを示す組立て斜視図。

【図2】図1に示した記録ヘッドの断面構造を示す図。

【図3】図1に示した流路ユニットを示した組立て斜視図。

【図4】図1に示した流路ユニットの製造に使用する板材の一例を示した斜視図。

【図5】(a)、(b)は、それぞれ、本発明の第1実施形態において、図4に示した板材をプレス加工する第1、第2の金型の一例を示した斜視図。

【図6】(I)乃至(IV)は、図4に示した板材の加工工程を、圧力発生室の軸方向の断面構造で示した図。

【図7】(I)、(II)は、図4に示した板材の加工工程を、圧力発生室の列設方向の断面構造で示した図である。

【図8】図1に示した記録ヘッドの製造方法の第1変形例における製造途中の板材の断面構造を示した図。

【図9】図(I)乃至(IV)は、図1に示した記録ヘッドの製造方法の第2変形例における板材の加工工程を、圧力発生室の軸方向の断面構造で示した図。

【図10】(a)、(b)は、それぞれ、図1に示した記録ヘッドの製造方法の第2変形例において板材をプレス加工する第1、第2の金型を示した斜視図。

【図11】(I)、(II)は、図1に示した記録ヘッドの製造方法の第2変形例における板材の加工工程を、圧力発生室の列設方向の断面構造で示した図。

【図12】(a)は、本発明の第2実施形態によるインクジェット記録ヘッドの要部を示した平面図、(b)は(a)のA-A線に沿った断面図。

【図13】(a)、(b)は、それぞれ、本発明の第2実施形態において、図4に示した基板をプレス加工する第1、第2の金型を示した斜視図。

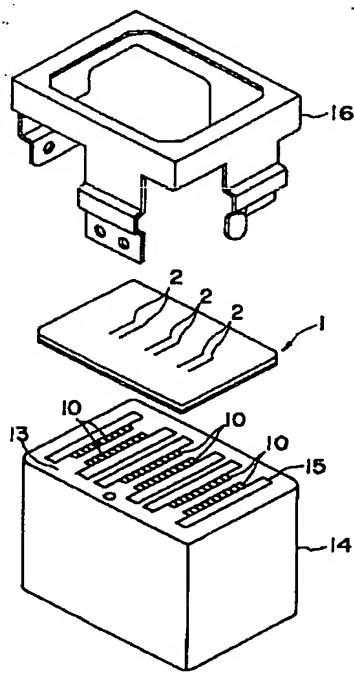
【図14】(a)は、本発明の第3実施形態によるインクジェット記録ヘッドの要部を示した断面図、(b)は第1板材を示した平面図、(c)は第2板材を示した平

面図。

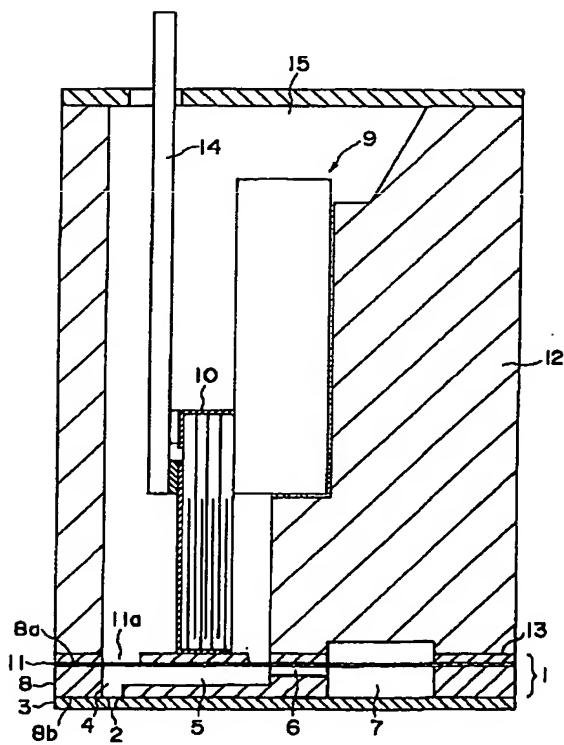
【符号の説明】

- 1 流路ユニット
- 2 ノズル開口
- 3 ノズルプレート
- 4 ノズル連通孔
- 5 圧力発生室
- 6、41 インク供給口
- 7 リザーバ
- 10 8、40、50 流路形成基板
- 8a、40a 流路形成基板の第1面
- 8b、40b 流路形成基板の第2面
- 10 圧電振動子
- 20 リザーバとなる貫通孔
- 21 金属板材
- 42 供給口連通孔
- 51 第1板材
- 51a 第1板材の上面(第1面)
- 51b 第1板材の下面(第4面)
- 20 52 第2板材
- 52a 第2板材の下面(第2面)
- 52b 第2板材の上面(第3面)

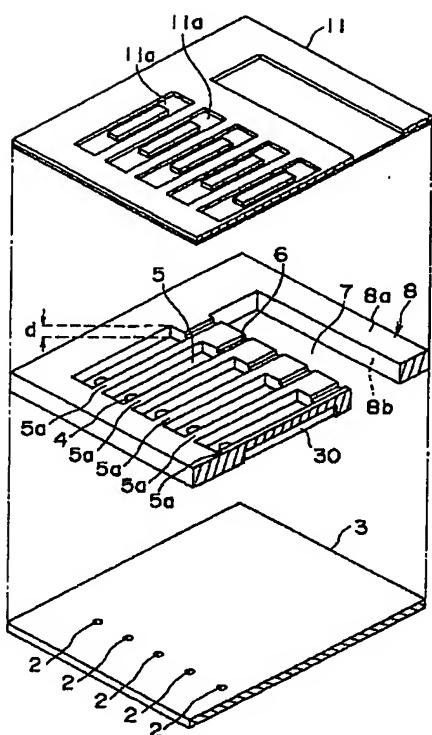
【図1】



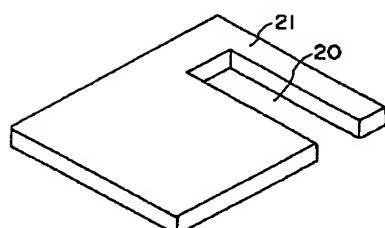
【図2】



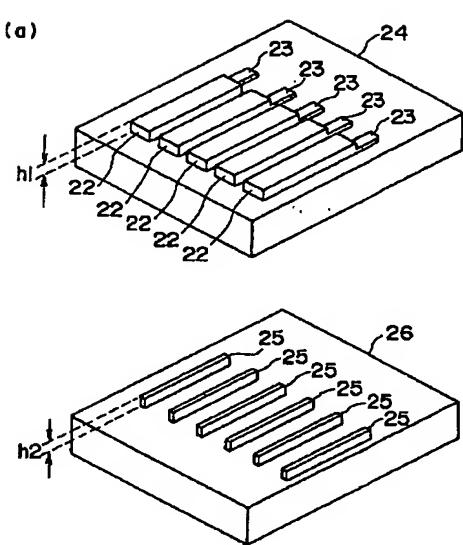
【図3】



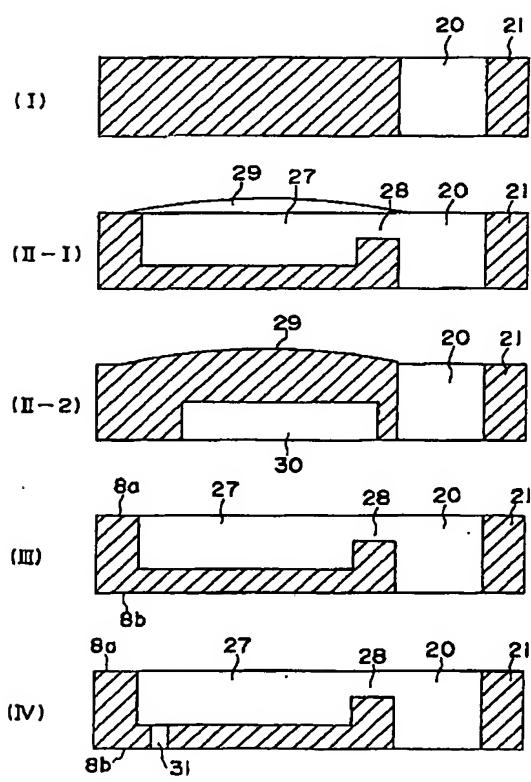
【図4】



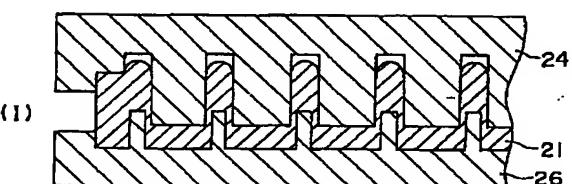
【図5】



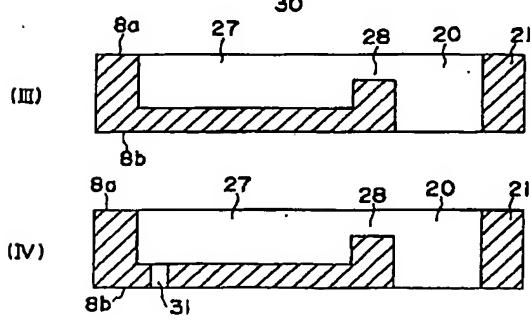
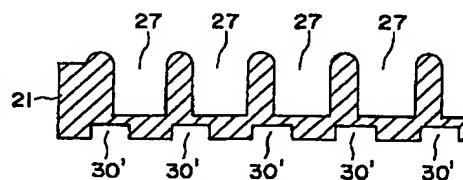
【図6】



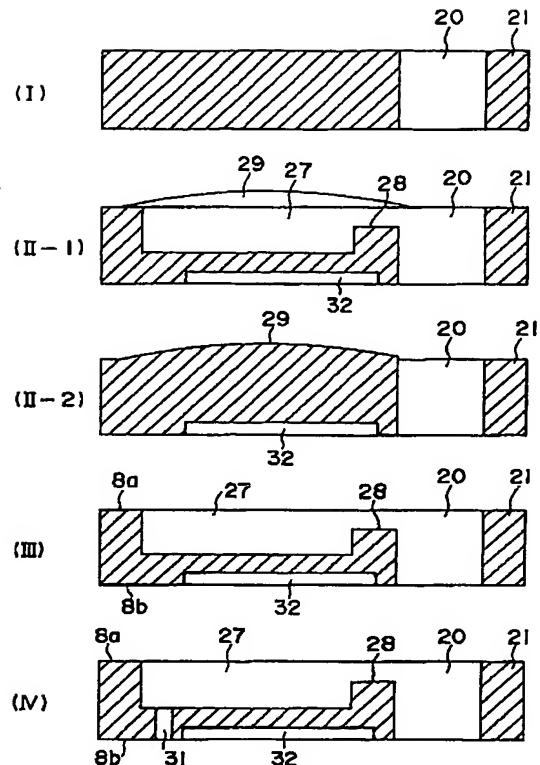
【図7】



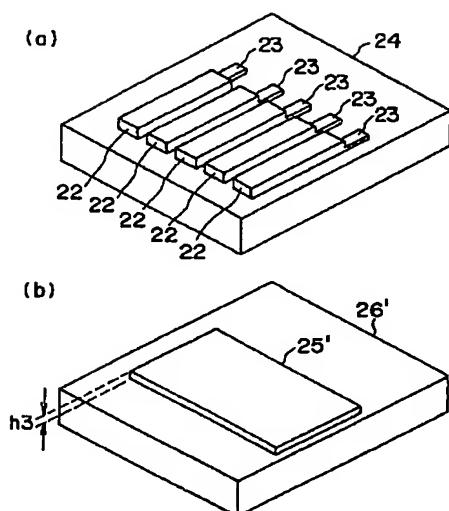
【図8】



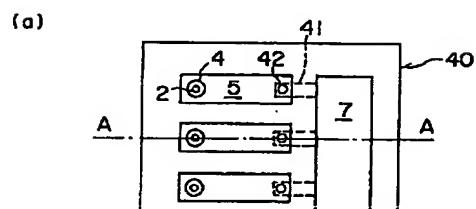
【図9】



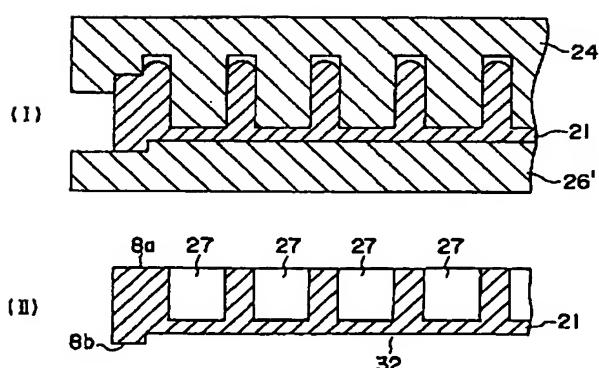
【図10】



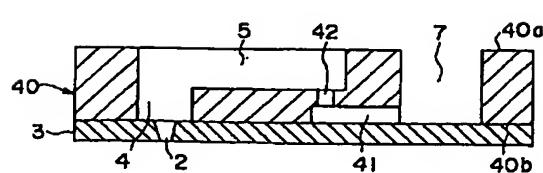
【図12】



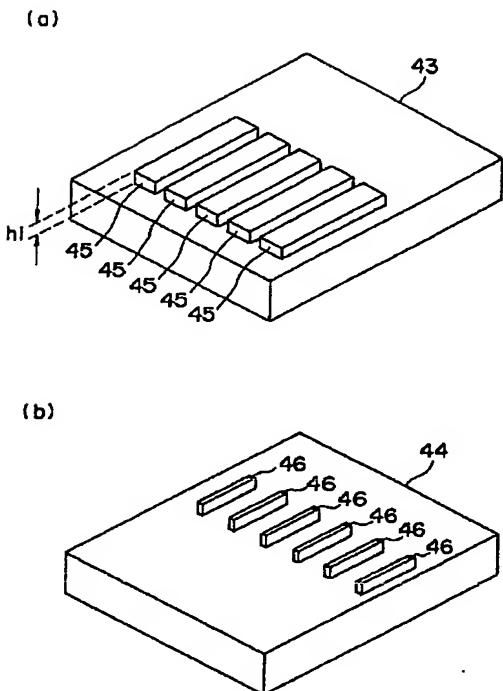
【図11】



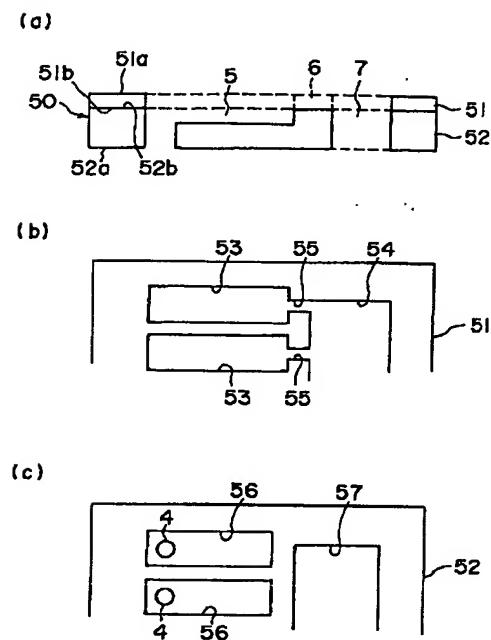
(b)



【図13】



【図14】



---

フロントページの続き

(72)発明者 北原強  
長野県諏訪市大和三丁目3番5号 セイコ  
ーエブソン株式会社内

Fターム(参考) 2C057 AF24 AP65 AF93 AG12 AG45  
AG48 AP02 AP16 AP22 AQ06  
BA04 BA14